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The Genesis of Jefferson's Plan for the University of Virginia

By Fiske Kimball

Illustrated with Original Plans

WITH the ever-increasing recognition of the great merits of the design of the University of Virginia, and the recurrent scepticism on the part of architects that Jefferson himself could have composed it, fresh theories are always being put forward to account for its origin.

The latest of these, widely proclaimed from the lecture platform, is that it was derived from Guennepin's Grands Prix of 1805, an "Établissment de six familles," having a building containing reception halls in common, separate houses for each family, with private gardens and service buildings, and communications under cover (Figures 1 and 2). Here is, to be sure, the equivalent of the "pavilions" of the university, housing the professors, the colonnades of the lawn uniting them with a more important building on the axis, which dominates the group, as does the rotunda in Virginia (Figure 6).

Although Jefferson returned from Paris in 1789, the derivation is rendered physically possible by the publication of the design in the first volume of Grands Prix in 1806. At first glance it seems like a clear case.

Let us look into the matter a little more closely. Jefferson was not out of Virginia during the years in question (1809–1826). By his library catalogues we know just what books he owned at different periods. The Grands Prix were not among them, nor were they in the finest American library of the time besides his, that of the Library Company of Philadelphia. All his correspondence is preserved in copies, including a request to borrow De Lorme's book for the method of framing the dome of the rotunda at the university. There is no letter asking for the Grands Prix.

Jefferson's preliminary studies for the university are preserved. If he was working from Guennepin's design, we should expect the first studies to show the same *parti*, the fundamental similarities. We find, on the contrary, that the first studies were very different. They are connected with the executed work by successive steps, for every one of which the reasons are known, and which explain the genesis of the design without any recourse to Guennepin's Grands Prix.

Jefferson's first idea, "of an academical village rather than one large building," was formed about 1802 when he was consulted by L. W. Tazewell, of the Virginia Legislature, on the subject. A sketch from 1804–1805 in possession of the Massachusetts Historical Society shows the pavilions

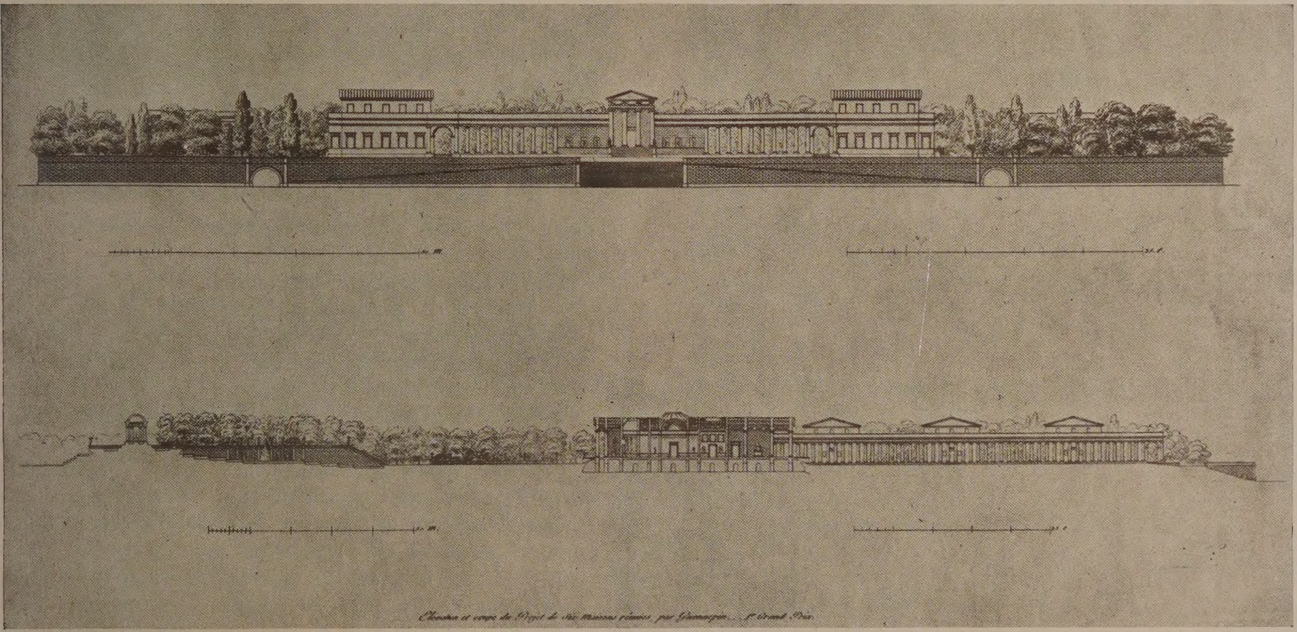

Élévation et coupe du Projet de six Maisons réunies par Guennepin . . . 1er Grand Prix.

Fig. 3. Guennepin's Grand Prix of 1805. Elevation and section.

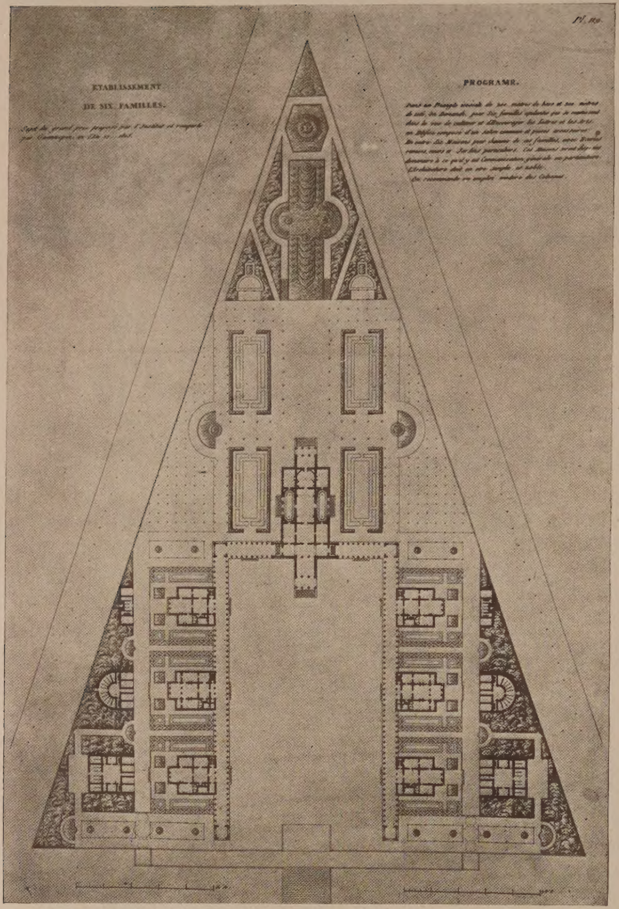


Fig. 2. Guennepin's Grand Prix of 1805. Plan. "L'Etablissement de six familles."

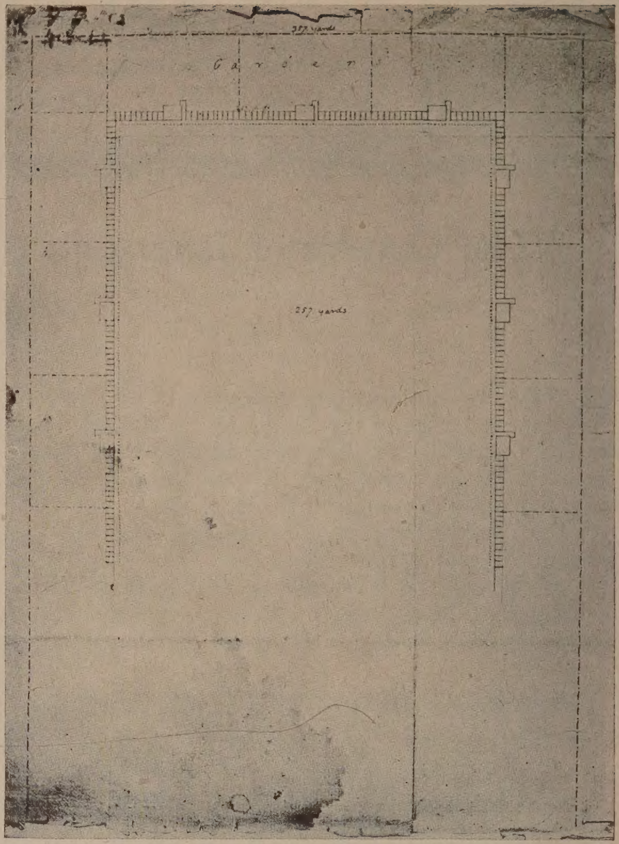


Fig. 4. Jefferson's Sketch Plan for the University, 1817

and adjacent "dormitories," or cubicula, without porticos or colonnades. In 1810 the conception as presented to the trustees of East Tennessee College already included the "covered way to give a dry communication between all the schools. The whole of these arranged around an open square of grass or trees." The first sketches for the plan, in 1814 and 1817 (Figure 4), show the pavilions all equal, arranged three each on three sides of a single great square, having little resemblance to Guennepin's group. This was the form in which Jefferson sent it to Thornton, May 9, 1817, and to Latrobe June 12 of the same year, asking suggestions for variety in the treatment of the individual pavilions. "But this," as he wrote Latrobe again on August 3, "was all before any actual site was acquired. . . . The site is lately bought and on a survey it is a narrow ridge . . . so as to give us a width between the two rows of pavilions of 200 feet only." Meanwhile Latrobe had sent him on July 24 a sketch (Figure 5) proposing to emphasize the axis with a "more important centre building which ought to exhibit in mass and details as perfect a specimen of good architectural taste as can be devised." The idea of placing there "something of the grand kind," Jefferson adopted in his reply; and in the subsequent plans for the group, in which boarding houses or "hotels" for students were added in outer ranges beyond the lines of the narrowed lawn (Figure 6).

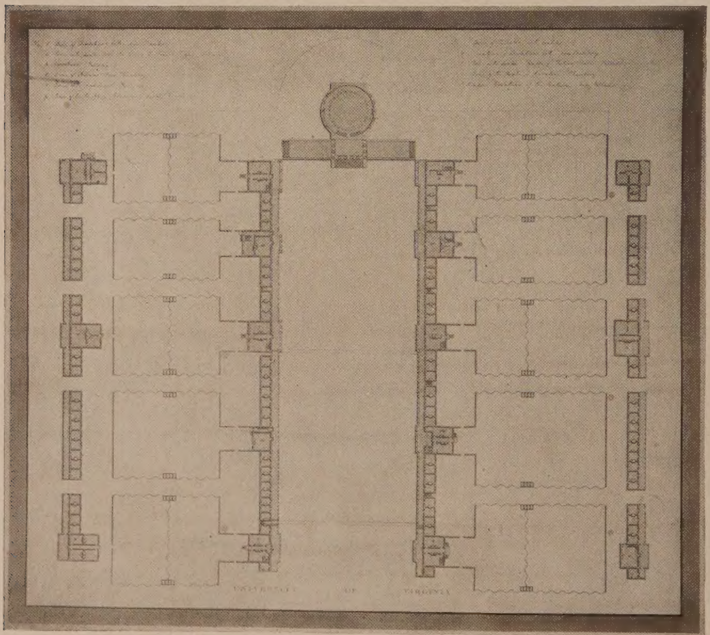
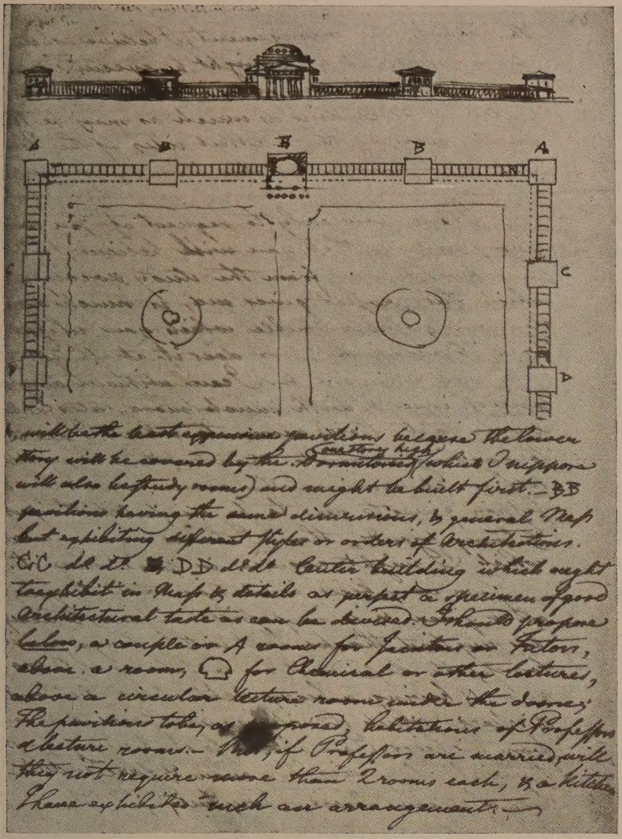


Fig. 1. Plan of the University of Virginia. From the engraving by Peter Maverick. Courtesy of Clara Amory Coolidge.

So far as the style of the buildings in elevation is concerned, Jefferson did not need Guennepin's design, nor even Latrobe's, to inspire him to imitate the temple. He had done it long before 1806, conspicuously in his Virginia Capitol (1785), which, as I have pointed out elsewhere, long antedates the great executed examples abroad such as the Madeleine (1807). Three of



will be the most expensive pavilions, because the lower story will be covered by the Dormitories (one story high) which I suppose will also be study rooms) and might be built first. — BB pavilions having the same dimensions, & general Mass but exhibiting different styles or orders of Architecture. CC do do DD do do Center building which ought to exhibit in Mass & details as perfect a specimen of good Architectural taste as can be devised. I should propose below, a couple or 4 rooms for Janitors or Tutors, above, a room, for Chemical or other lectures, above a circular lecture room under the dome; The pavilions to be, as proposed, habitations of Professors & lecture rooms. — But, if Professors are married, will they not require more than 2 rooms each, & a kitchen I have exhibited such an arrangement. —

Fig. 5. Latrobe's Sketch Plan Proposing Emphasis on the Central Building of Jefferson's Scheme.

his pavilions indeed followed suggestions by Thornton and Latrobe, but in others he outdid these in classical literalness by adopting the form of the pro-style temple without modification. For the "centre building" too he went beyond Latrobe's domed and half-domed cube to direct imitation of the Panthéon itself.

The similarities between Guennepin's Grand Prix and the plan of the University of Virginia are thus not due to copying one from the other, but are rooted in the similarity of the programmes and in the pervading classical style of the time, of which Jefferson himself had been one of the pioneers.

That McKim, Mead & White, known to be students of the early Grands Prix, noticed the similarities and used the plates at the time of the restoration of 1896 is disproved by the memory of surviving partners. Their treatment of the covered walks enclosing the new gardens to east and west of the rotunda, with colonnades terminating in a single bay of the Roman arch order, is closely similar to the motive in Guennepin's elevation (Figure 3).

If one must seek a prototype for the University of Virginia group as it took final form in Jefferson's mind after he knew the limitations of the site, there is a far more famous example of such a grouping: Marly-le-Roi, which Jefferson had visited on September 7, 1786 (Figure 7). Here, since destroyed by the Revolution, was a group long in existence, rivalling Versailles itself in reputation, with the same fundamental composition, the individual pavilions for favored courtiers grouped in two lines leading up to the casino of the *Roi Soleil* (Figure 7). It is possible that a belated reminiscence of Marly, as the great exemplar of the type to which Guennepin's design also belongs, helped to determine Jefferson's ultimate plan, but here too we must recognize that this was primarily the result of the same functional analysis of the problem Jefferson, our first Paris trained architect, learned there quite as much as Guennepin, or as the most recent returned élève.

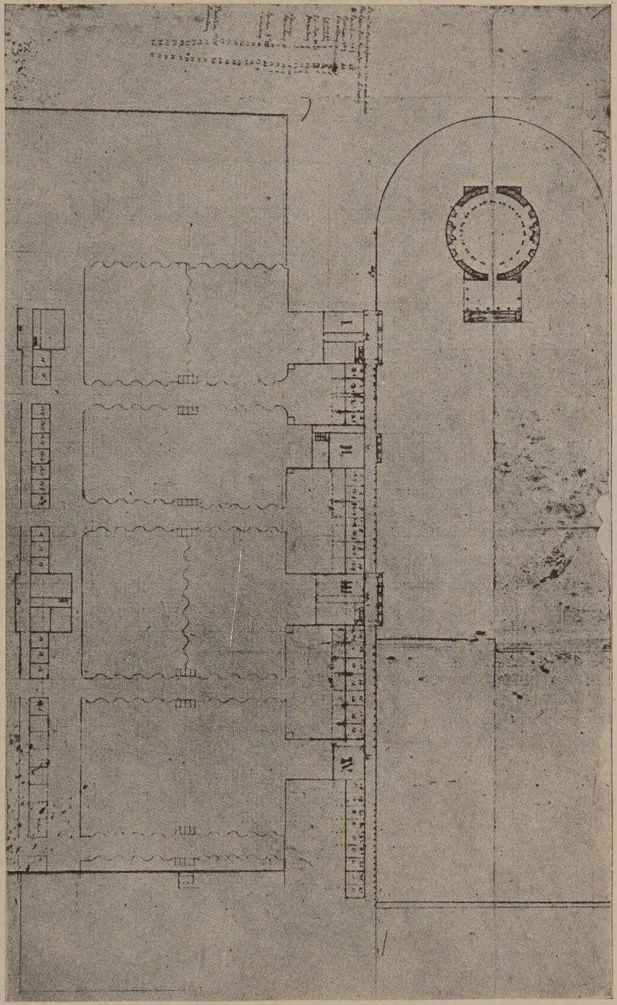


Fig. 6. Jefferson's Final Sketch for the Plan of the University, 1819.

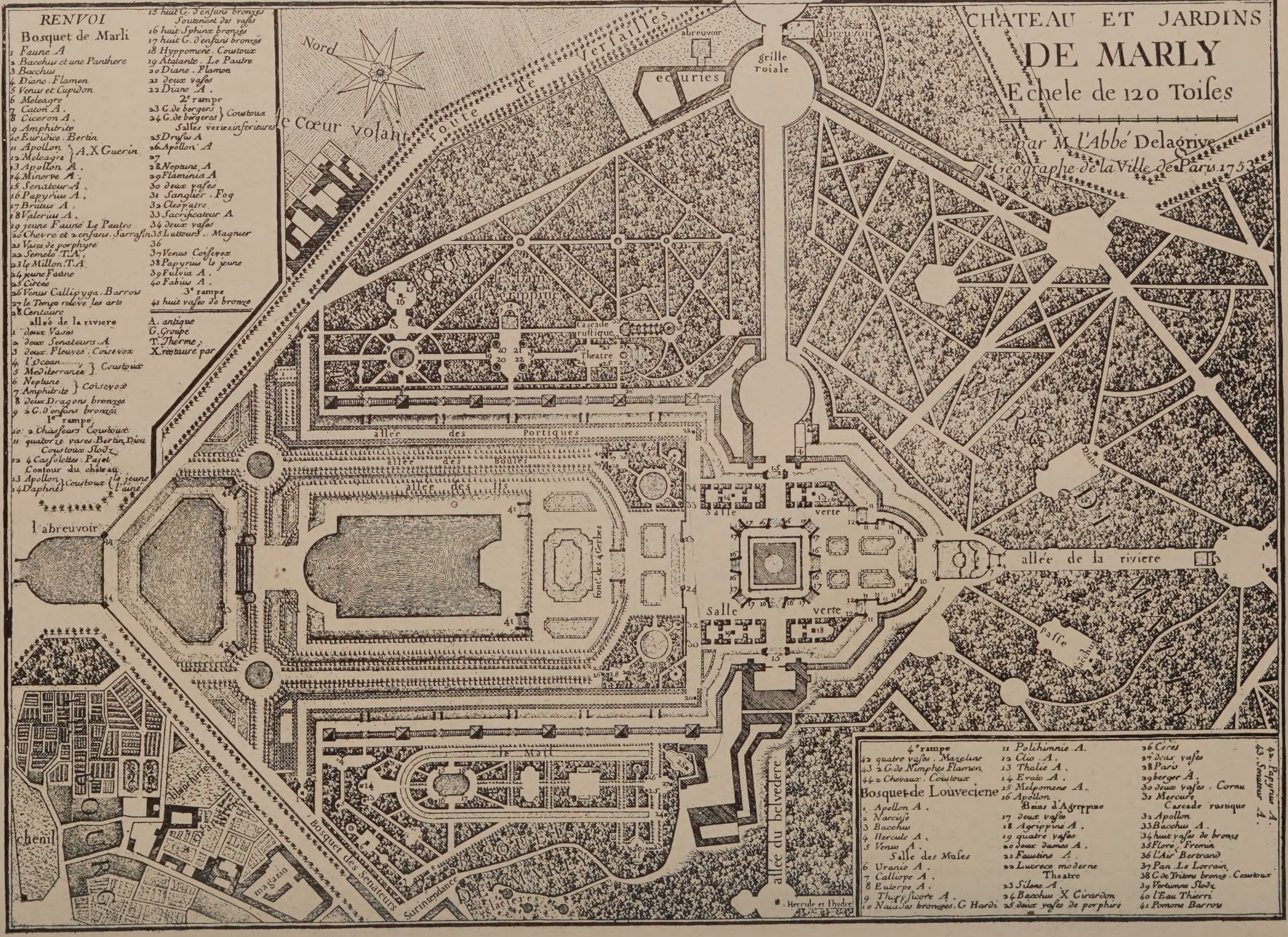
To Stimulate Art in Industry

A COMPETITION for American artists, enabling the winner to study in the Paris ateliers of the New York School of Fine and Applied Art, is announced by Frank Alvah Parsons and a committee of judges which includes society leaders, architects, and decorators.

The scholarship, of $500, providing transportation to and from France, and one year's tuition, is offered to stimulate interest in interior decoration and architecture among the American people, and will be awarded to the American student of art and decoration who submits the best decorating and furnishing scheme for a five-room apartment.

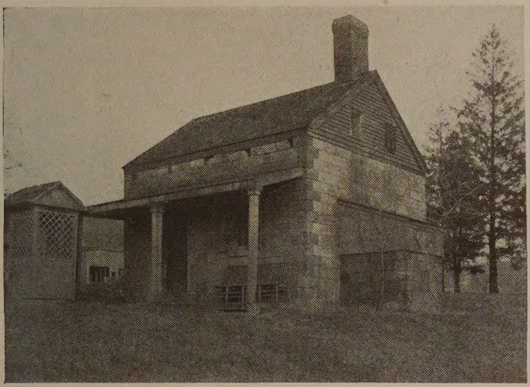
The scholarship is offered by E. A. MacDougall, president of the Queensboro Corporation, of New York.

The competition closes January 31, 1924. Plans should be presented to the secretary, J. Mitchel Thorsen, 9 East 46th Street, New York City.


CHATEAU ET JARDINS
DE MARLY
Echele de 120 Toiſes
par M. l'Abbé Delagrive
Géographe de la Ville de Paris 1753
Nord
le Cœur volant
route de Verſailles
abreuvoir
grille roiale
ecuries
Abreuvoir
allée des Portiques
allée des boules
allée des ifs
font des 4 Gerbes
Salle verte
Salle verte
allée de la riviere
Diane
Paſſe
Theatre
Caſcade ruſtique
le Mail
allée du belvedere
Hercule et l'hydre
Bosquet des Senateurs
Surintendance
magazin
chenil
l'abreuvoir
RENVOI
Bosquet de Marli
1 Faune A
2 Bacchus et une Panthere
3 Bacchus
4 Diane. Flamen
5 Venus et Cupidon
6 Meleagre
7 Caton A.
8 Ciceron A.
9 Amphitrite
10 Euridice. Bertin
11 Apollon } A. X Guerin.
12 Meleagre }
13 Apollon A.
14 Minerve A.
15 Senateur A.
16 Papyrius A.
17 Brutus A.
18 Valerius A.
19 jeune Faune Le Pautre
20 Chevre et 2 enfans. Sarraſin
21 Vases de porphyre
22 Semele T.A.
23 le Millon T.A.
24 jeune Faune
25 Circée
26 Venus Callipyga. Barrois
27 le Temps releve les arts
28 Centaure
allée de la riviere
1 deux Vases
2 deux Senateurs A
3 deux Fleuves. Coisevox
4 l'Ocean } Coustoux
5 Mediterranée }
6 Neptune } Coisevox
7 Amphitrite }
8 deux Dragons bronzes
9 2 G. d'enfans bronzés
1e rampe
10 2 Chaſseurs Coustoux
11 quatorze vases. Bertin, Dieu Coustoux Slodz
12 4 Caſsolettes. Pajet
Contour du château
13 Apollon } Coustoux { le jeune
14 Daphné } { l'aîné
15 huit G. d'enfans bronzes Soutenant des vaſes
16 huit Sphinx bronzés
17 huit G. d'enfans bronzés
18 Hyppomene. Coustoux
19 Atalante. Le Pautre
20 Diane. Flamen
21 deux vaſes
22 Diane A.
2e rampe
23 G. de bergers } Coustoux
24 G. de bergeres }
Salles vertes inferieures
25 Druſus A
26 Apollon A
27
28 Neptune A
29 Flaminia A
30 deux vaſes
31 Sanglier. Fog
32 Cleopatre
33 Sacrificateur A
34 deux vaſes
35 Lutteurs. Magnier
36
37 Venus Coiſevox
38 Papyrius le jeune
39 Fulvia A.
40 Fabius A.
3e rampe
41 huit vaſes de bronze
A. antique
G. Groupe
T. Therme;
X. restauré par
4e rampe
42 quatre vaſes. Mazeline
43 2 G. de Nimphes Flamen
44 2 Chevaux. Coustoux
Bosquet de Louveciene
1 Apollon A.
2 Narciſse
3 Bacchus
4 Hercule A.
5 Venus A.
Salle des Muſes
6 Uranie A.
7 Calliope A.
8 Euterpe A.
9 Thypſicore A.
10 Naiades bronzées. G Hardi
11 Polihimnie A.
12 Clio A.
13 Thalie A.
14 Erato A.
15 Melpomene A.
16 Apollon
Bains d'Agrippine
17 deux vaſes
18 Agrippine A.
19 quatre vaſes
20 deux dames A.
21 Fauſtine A.
22 Lucrece moderne
Theatre
23 Silene A.
24 Bacchus X Girardon
25 deux vaſes de porphire
26 Ceres
27 deux vaſes
28 Paris
29 berger A.
30 deux vaſes. Cornu
31 Mercure
Caſcade ruſtique
32 Apollon
33 Bacchus A.
34 huit vaſes de bronze
35 Flore. Fremin
36 l'Air Bertrand
37 Pan. Le Lorrain
38 G. de Tritons bronze. Coustoux
39 Vertumne Slodz
40 l'Eau Thierri
41 Pomone Barrois
42. Papyrius A.
43. Senateur A.

The Dutch Colonial Farm-House

SCATTERED through the northern counties of New Jersey may still be found many examples of the Dutch farm-house in more or less good states of preservation; and the type merits more than casual notice, as it is of strictly local origin, no counterpart being found in any other country, nor in this country except those parts of New York State settled by the Dutch.



Slave-house, Huyler Homestead, Cresskill, N. J.

The Jersey houses were built of local red sandstone, which was of glacial origin and therefore easily obtained from the surface of the fields. Like the modern bungalow, the houses were of one story and attic, the first floor being used as living quarters and the attic for storage. Gradually dormer windows were introduced and the attic was also used for living purposes.

The walls were laid up, twenty-four inches or more in thickness, to the level of the second floor beams, the stone being squared in random sizes and for the front of the house, faced in a very workmanlike manner. Unfortunately, lime mortar was hard to obtain and cement mortar was not yet known, so that it was necessary to use clay mud to fill the joints. This was the weak point in an otherwise good job of masonry.

The most interesting as well as the distinguishing feature of the Dutch house is the gambrel roof, a type originated by the Dutch. A somewhat flat pitch was broken near the ridge and from there carried out in a graceful curve, well over the edge of the wall. The object of the overhang was to protect the clay mortar in the wall-joints from rain, as it was easily washed out and leaks resulted. Often the roof in front of the house was brought forward several feet and supported by pillars, square, round or box, according to taste or convenience, from a platform, thus forming a stoop. The roof timbers were enormous compared with those in use to-day, were hand-hewn and air-dried. They were covered with rough roofers and these in turn with hand-split shingles. These shingles are marvellous as to durability. The writer has one in his possession, taken from one of the old houses, which was on the roof at least one hundred and twenty-five years, and it is as fresh and sound as when made. It is thirty inches long, eight inches wide, and one inch thick at the heaviest part. Nine inches at the butt were exposed to the weather, and this surface shows a loss of one-eighth inch in thickness, due to the wear of the elements. In all other respects it is a new shingle.

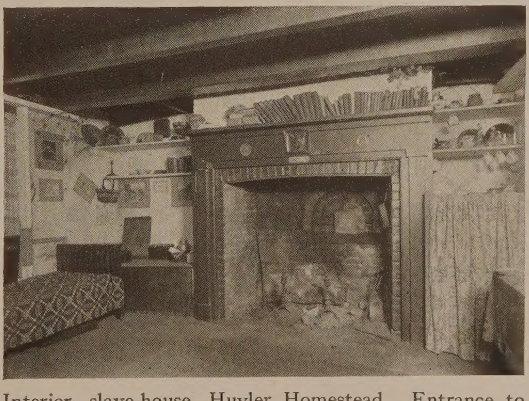
The gables were usually framed up from the second floor level and covered with clapboards, and pierced with quarter-round windows. Here we see an attempt at decoration at a loss of utility, as these windows were of little use for ventilation.

The chimneys were of brick and always built inside the house; the kitchen chimney sometimes having an offset on the outside of the house, which was used as an oven. As labor was cheap and as the heating arrangements demanded many flues—dependence being entirely on open fires—there were many chimneys, sometimes as many as six to a house.

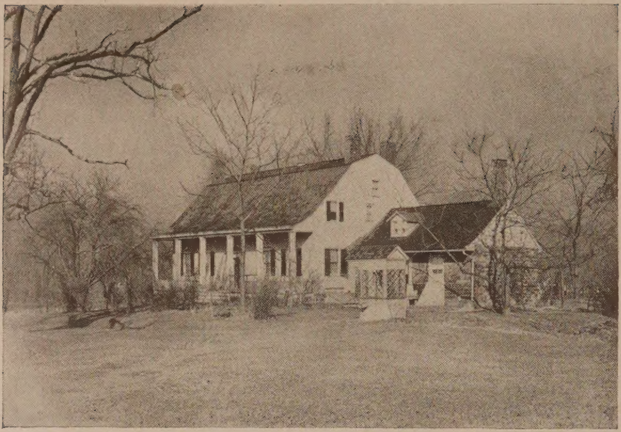
As time passed new ideas crept in, some good and some the reverse. Dormer windows were let into the sweep of the roof, giving light and air to the second floor, so that it could be used for bedrooms, and extensions either of brick covered with stucco or of frame construction were added as wings or in the rear. These additions generally had single pitched roofs and "belly-gutter" windows under the cornice. It may here be mentioned that in some instances smaller buildings of the same general type and construction as the main houses were erected nearby, for the housing of negro slaves or white bond-servants, for in those days both were held in New Jersey.

The trim of the old houses, as might be expected in farm-houses, was rather plain, although there are some mantels of more than ordinary excellence and the main entrances were quite elaborate. The panelled doors were flanked by sidelights of leaded glass, with fanlights of the same material above. The hardware was blacksmith-made and probably not much regarded then, although to-day priceless. The only occurrence of fake building entering into these houses is found in the treatment of the door and window openings. The lintels were made of oak timbers, let into the masonry, and were covered with boards painted to represent stone and furnished with a wood keystone. Had cement been known at that time it would probably have been used, colored to match the wall.

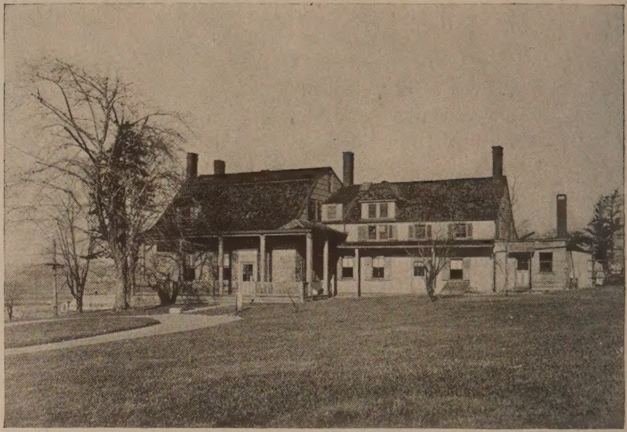
To one contemplating the building of a home in the country, a more than cursory study of the Dutch house would be of advantage, as it is a type adaptable to varied requirements, can always be enlarged, and if well placed looks a part of the landscape. Indeed, a faithful copy, in so far as architect and contractor would permit, would make an ideal home.



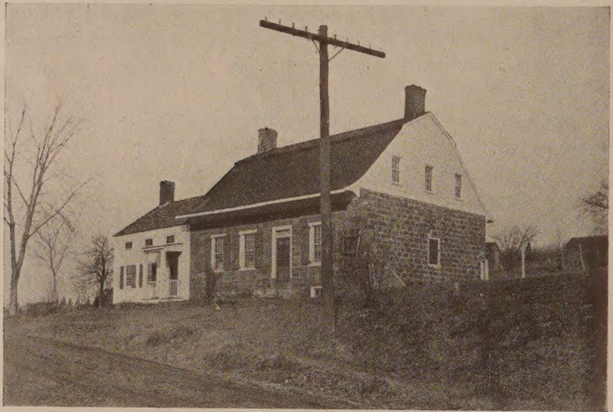
Interior, slave-house, Huyler Homestead. Entrance to oven shows in back of fireplace.



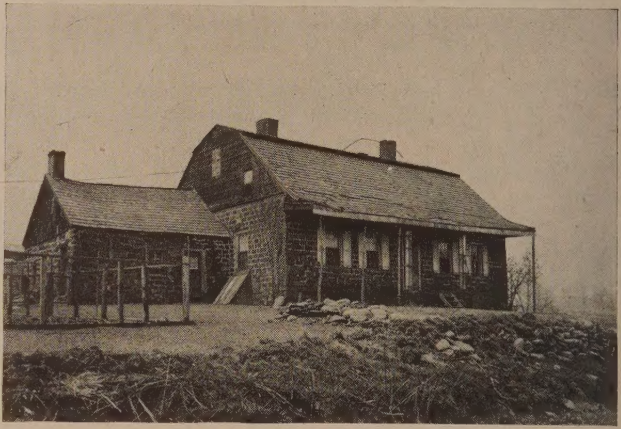
Grand Avenue, Englewood. One of the very few Dutch Houses built of wood. The stone wing was probably the original house.



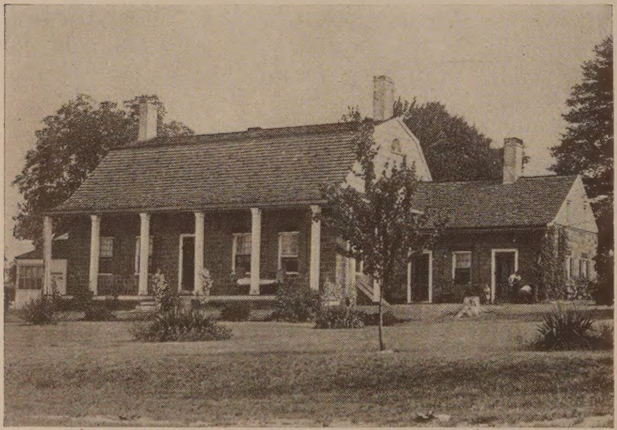
Grand Avenue, Englewood. The wing is of later date than the main house.



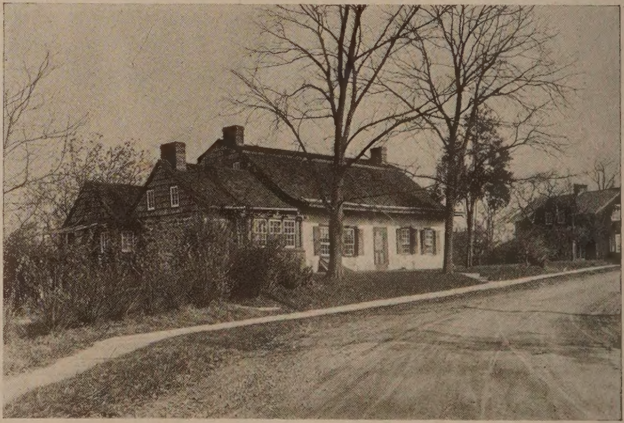
House near Ridgewood. Notice the frame wing of later date, with "belly-gutter" windows.



Brinckerhoff House, Hasbrouck Heights, N. J. A good type but gone to seed.

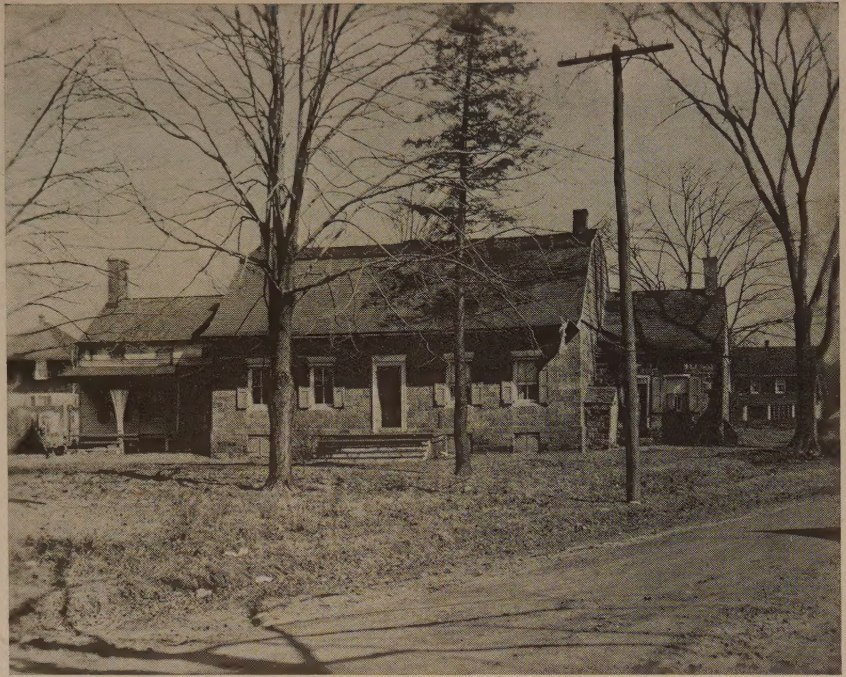


P. A. B. Westervelt House, Cresskill.

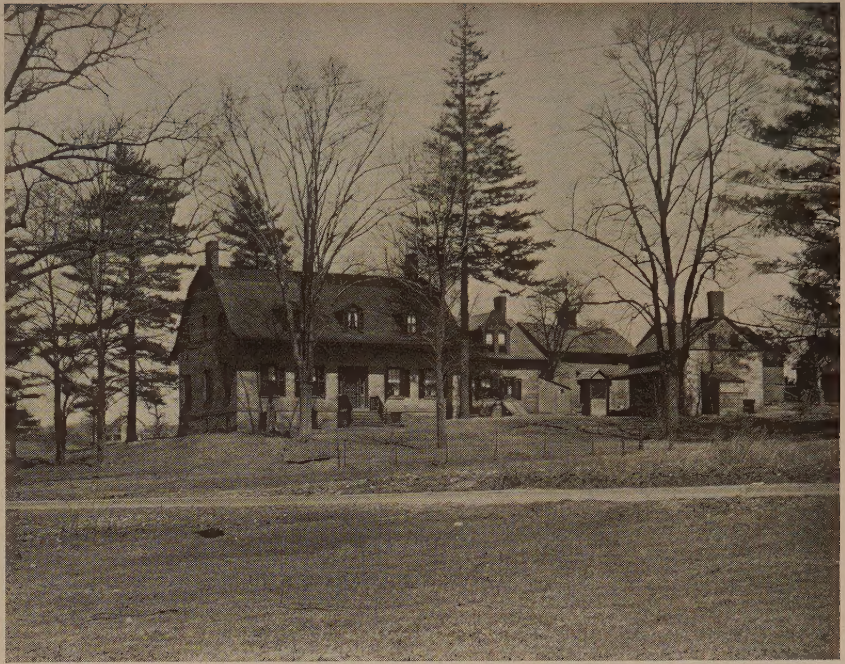


River Edge, N. J. The wings are of recent date. Notice the stuccoed front wall of main house.

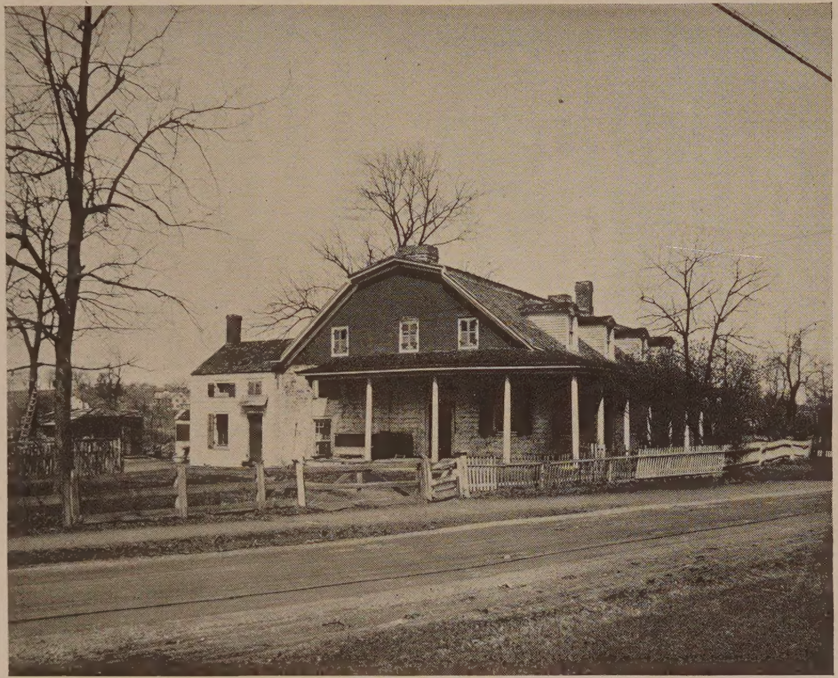
THE DUTCH COLONIAL FARM HOUSE.



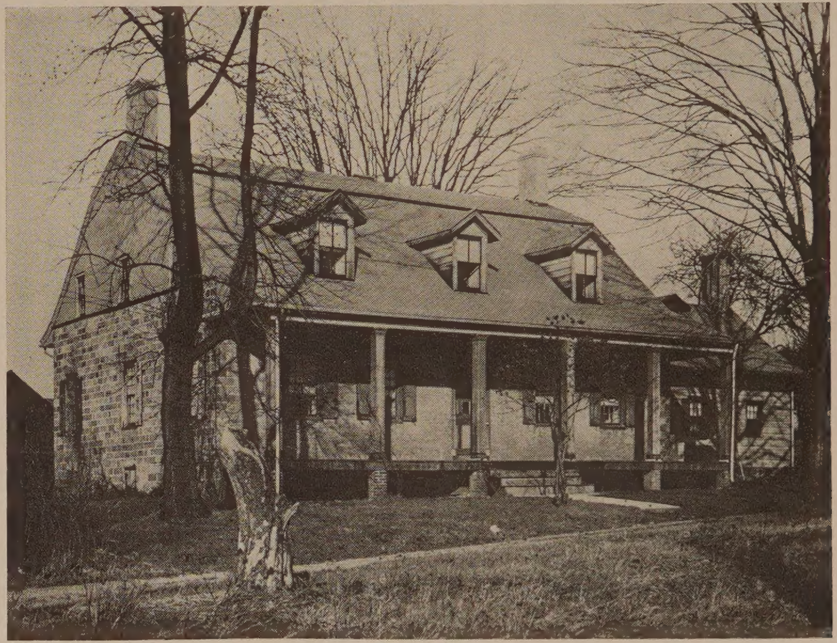
Westervelt House at Tenafly. The frame wing at the left is modern. The Dutch oven can be seen at the right of main building.



Huyler House, County Road, Cresskill. Built about 1804. Slave house can be seen at the right.



Steuben House, New Bridge, N. J. Given to Baron von Steuben by the State of New Jersey for his services in the Revolution.



House on Schraalenberg Road, near the New York State Line. Character ruined by patent roofing material.

THE DUTCH COLONIAL FARM HOUSE

The Architect *vs.* the Public

DOES the public know the architect? It knows the names and sees the pictures of the leading men of every other calling. If an author, statesman, or baseball star comes to town society leaders and the hoi-poloi scramble to see the great man. They want to see the man who can produce so wonderful a thing as a book or a statue or a famous painting. People travel, and the guide books are full of the names of painters and sculptors, the authors of the work they came to see. Every large city is full of great works of architecture more wonderful in conception and intricate execution than any book or any painting, and these are passed by as of little personal interest as if they just grew, somehow, as a matter of course.

The public, composed of persons, is interested primarily in greater persons, secondarily in what they do. The public never hears of an architect, never sees one as it sees other men of achievement, does not connect a person with the building produced, hence takes little interest in architecture.

The speaker was a reporter and journalist for thirty years and had seen, if not talked to, almost every American man of achievement in every walk of life during that time. He had seen much of the work of many leading architects but never saw one of the architects, never even heard the names of most of them. In fact his chief interest in coming to this meeting was the hope of seeing some of these peculiarly modest (he might have added, indifferent, temperamental, snobbish, etc.) beings in their lair. (At least a few of Chicago's noted architects were not visible even there.)

The public is occasionally aware, for a moment, of an attractive building. Immediately its attention is distracted from the structure to the bank that financed it, the realtor who negotiated it, the person or firm that owns it, and the concern that occupies it, the contractor who builds it, the plumber, the decorator, and everybody concerned except the architect who conceived its form, arranged its intricate parts and functions, and became responsible for its beauty, its safety, the integrity of its execution. An appreciation of the personality that made it is entirely lacking. If the public thinks of the architect at all it is of the man who makes the pretty picture or operates the mysterious machine that produces the blue prints.

Whose fault is it? How can the public appreciate art without knowing something of the personality that produces it? Architecture is a personal product. School children understand this to be so regarding literature, painting, sculpture, music, drama, and these authors' names and something of their process of production are dwelt upon.

Even battles are won or lost by generals, and the personalities causing defeat or victory are studied. Where is the long list of buildings and their dates and authors and their effect on the progress of civilization? Are the houses we live in and the buildings we see and move about in of no importance to the expanding human souls in our public schools and colleges? Is the training and integrity of the architect and the education and environment that enabled him to produce the most useful, most wonderful, most enduring objects of all civilization of no interest, no moment to the generations that must reproduce and improve? Unless an appreciation of the character and integrity of architects and architecture and all the progeny of formative arts related to architecture, the industrial arts, is fostered, the fundamental amenities of our civilization will continue to decline and architects and craftsmen continue to become extinct.

The architect must come out of his unwarranted seclusion and do his part in forming favorable public opinion for his works and kindred arts. Architectural societies must abolish restrictive measures and inaugurate constructive measures for impelling public recognition of the fine high character and structural integrity of the architect and his works. The cry of "advertising" and the dread of "publicity hunter" are considerably overdone, and the public, knowing what publicity means in other callings, does not understand this reverse attitude of the architectural profession, to the great detriment of the profession and the injury of the generations of would-be artisans.

The architect of to-day can do much if he but will to hasten the time to come when proper publicity, the force that to-day moves minds and hearts as deeply as it moves dollars and goods quickly, will be availed of by the architect to further not more his individual gain than the education of all the people in what is good, true, and beautiful in architecture.

When the time comes that both the architect and the public are thoroughly trained in high ideals, architects and architecture will receive the appreciation of a sympathetic public and the arts will be automatically advanced, as they should be in a progressive civilization, to heights of perfection and enjoyment not hitherto dreamed of by the most prophetic poets.

From the Leaflet of the Chicago Chapter of the American Institute of Architects.

The New Hotel Franciscan, Albuquerque, New Mexico

Trost and Trost, Architects

THIS unique and picturesque building, so in keeping with the local traditions of design, is modern and up-to-date in its every equipment.

The structure has 143 rooms, all of which face the out-of-doors. It has 50 rooms with bath. It has 20 rooms arranged with bath between rooms. It has 30 rooms arranged with shower bath between rooms. It has 29 rooms which have no bath but are equipped with private toilet. It has 6 rooms without bath that have private toilet between two rooms. It has 8 rooms with neither bath nor toilet. Each room has private lavatory. Six rooms, 2 on the second, third and fourth floors, have in-a-door beds.

The building contains 100 rooms with private bath or shower between two rooms. It has 135 rooms with private toilet or toilet between two rooms.

The style of architecture adopted for the hotel made it possible to arrange all rooms with outside exposure. This feature has been found to be highly valuable; almost as valuable as the distinctive character of the building.

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Editorial and Other Comment

Who Was the Architect?

IF one were walking down Broadway with eyes and mind centred on a study of the architecture of the high buildings, and should stop some of the hurrying crowd to ask, "Who was the architect of the Woolworth Building?" we wonder how many of the asked could tell. No one would lack the information that it was the Woolworth Building; that fact is probably known from Maine to Kamchatka, for the fame of the five-and-ten shops is something that has travelled around the wide world. Probably some of the folks asked could tell you, without hesitation, the number of stories the building extends toward the skies, and a few might guess at the money it cost.

But the name of the architect—well, we wonder. It would be the same with almost any building you might name; in fact, we doubt if one person in a thousand could tell you the names of three architects to whose genius and knowledge we owe the wonder of the outstanding down-town skyscrapers.

Now, this is not right, and we think something should be done about it. How proceed? is the question. If we were advertising the Woolworth Building, we should be proud to state that the man who made it possible was Cass Gilbert, just as we should point out the fact that the painter of our favorite American picture was, let us say, Wyant or Murphy or Inness. No traveller in London would fail to be reminded that St. Paul's Cathedral was designed by Sir Christopher Wren, or visitor in Rome would miss the name of Michael Angelo in looking at St. Peter's. But Mr. Gilbert's cathedral of business, as it has so often been called, is quite as great a wonder.

We go about the Old World, guide-book in hand, picking out famous buildings and taking pride in the knowledge that we know the names of the men who built them. We should be ashamed to be lacking in the same interest in the work of our modern men of genius and imagination. These so-called skyscrapers are among the world's wonders, and if they survive the ages, as have the Old World buildings, future generations, made up of the mixed races of which our New World will be composed, will write the names of their creators large in the guide-books.

The trouble has been with the architect himself, and with the very decent canons of ethics that have governed his profession. As a rule, he doesn't even hang out a shingle on his building, and the passer-by who stops to watch the going up of some new wonder will have to ask the men who are putting it together if he wants to know who is the architect. Why shouldn't the architect sign his building just as the painter signs his canvas? From the standpoint of educating the public in matters of art we think it quite as important—yes, more so. We can look up the name of a painter in the catalogue of the gallery or museum, but in many of the guides that tell about everything else concerning a building, the name of the architect is often omitted.

We should like the barkers on the rubber-neck wagons to appreciate that, in giving the names of the architects of the notable buildings they point out, they are showing themselves better qualified for their jobs. But, seriously, isn't it about time that we recognized that we owe it to the men who are writing the record of our busy civilization in their work, who are designing these wonderful monuments of great commercial enterprises, something more than just a passing and casual mention?

We dare say that there are even architects who would find it hard to tell you the names of their fellow practitioners identified with some of the recent and very interesting purely commercial structures in various centres of population.

About the only way we can keep track of the new things being done all about us is to follow pretty closely the shows of the various architectural exhibitions, like the one of the Architectural League in New York and the one held in Chicago and other cities and the architectural magazines.

Once a building is completed we forget the designer and look to the next novelty. But we believe, as we have said above, that the architect's work should be made known as widely as the work of the painters whose pictures hang in our houses and on the walls of the public galleries.

The Old and the New Fifth Avenue

THE twentieth century, age of skyscraper, congestion, and jazz, is about to take possession of upper Fifth Avenue. Already many of the magnificent homes that have made it the proudest street in America are for sale, and in their places will rise apartment buildings. The change is bound to come, and building restrictions and all the protests of those who would preserve the present character of the avenue can do no more than, perhaps, delay it.

The recent decision of the Appellate Division of the Supreme Court of New York declared the law restricting the height of buildings on the Avenue to seventy-five feet improper. If this decision holds it will permit the putting up of many new apartment-houses to take the places of some of the notable private residences that have for long been such interesting exhibits for the inquiring riders on the bus tops.

There are some of us who still remember the Avenue as a residential street, before business had begun its march from Fourteenth northward, before the street became the thoroughfare for most of the taxis in the land, and for the thousands of cars that have made Fifth the great gasolene trail.

The old order changes, and New York is too restricted in its land area to provide room for both business and private residences; besides the whole tendency of modern living seems toward compactness and the greater convenience of housekeeping provided by the large apartment all on one floor.

Park Avenue has become the street of luxurious and towering apartments for the rich, and if the decision of the court holds we shall expect to see Fifth repeat the picture presented by the west side of Central Park—one continuous row of apartments of massive walls and varying architecture, much of it of the sort that has, happily, been improved upon in more recent years.

No use in bemoaning the march of so-called progress. Mere beauty, light, air, and generous open spaces are not to be thought of when it comes to a matter of business.

There is a consoling thought for those of us who may retain any vestiges of sentiment about the passing of the old. By no possible chance can any of the apartments that may be built rival in architectural ugliness some of the palaces of the rich that have so long made upper Fifth an architectural hodge-podge and broken its sky-line into a jagged ridge of unrelated pinnacles and roofs. Our architecture has improved in many ways in recent years, and we have great faith in its future.

Here is something from an article appearing in a recent number of *The Nation*, written by Henry S. Churchill, about "The New Architecture":

"We need fewer artists and more architects; less art and more architecture. When we finally get that, we shall not need to look either humbly or reverently toward Athens, Rome, or Paris."

It seems to us that we need more architects who may be worthy also of being called artists. There is something in this from the same article worth consideration.

"Although there is slow but evident progress visible in our commercial work, it is nowhere visible in our public edifices, where the question of expense is not so fundamental, the desire for conspicuous waste often a ruling motive, and the dead hand of academic tradition falls most heavily. With the exception of the design for the Nebraska State Capitol, none of our recent public buildings show the slightest attempt to develop an architectural expression in accord with either the structural system or their surrounding civilization. Their steel frames are swathed in mummy-cloths. The absurdity of steel-framed masonry domes! The sterility of rows of useless columns! Endless modillions and garlands taking the place of imagination and suitable invention! How can they be other than ostentatious, dreary, and monotonous?"

Yes, "imagination and suitable invention!" but we must say that we find nothing "ostentatious, dreary, or monotonous" in Mr. Swartwout's beautiful and dignified design for the Missouri State Capitol, even though we heartily approve of and greatly admire the "suitable invention" shown in Mr. Goodhue's very original and progressive conception.

Deliver us from the imagination shown in some of the modern stuff that comes to us via Germany and Austria. We have the modernists with the paint brush "in our midst," and many of us have long since cried "Enough!"

We are inclined to think that Sir Christopher would have used a steel frame if it had been available for the dome of St. Paul's and we are quite sure that Michael Angelo would have been quick to appreciate the fact that steel would have been a most suitable and substantial substitute for one of his "two shells of masonry."

Big Gains in Building Throughout the Country

THERE are indications of a nation-wide revival of building activities, unusual at this season of the year. Official reports from 262 principal cities show 32 per cent gain over October last year and 26 per cent over September. In the last ten years October permits have lost as compared with September, excepting in 1922. These official reports, made to the national monthly building survey of S. W. Straus & Co., show regional gains over last October were: East, 26 per cent; Central, 46 per cent; Far West, 35 per cent; South, 7 per cent. Over September: East, 42 per cent; Central, 10 per cent; South, 13 per cent; Far West, 25 per cent. New York City gained 50 per cent over last October; Chicago, 86 per cent; Milwaukee, 179 per cent; Cleveland, 96 per cent; Cincinnati, 80 per cent; Los Angeles, 77 per cent; Detroit, 44 per cent; Portland, Ore., 69 per cent; Boston, 37 per cent.

The fifteen cities showing greatest amount of October permits issued were: New York, $72,903,031; Chicago, $27,837,350; Los Angeles, $20,541,872; Detroit, $12,485,880; Philadelphia, $10,949,310; Milwaukee, $6,047,773; Cleveland, $5,733,300; Baltimore, $3,854,988; San Francisco, $3,793,374; Boston, $3,556,341; Cincinnati, $2,886,860; Oakland, Calif., $2,759,208; Indianapolis, $2,757,826; Newark, N. J., $2,733,463; and Portland, Ore., $2,566,335.

The general volume of building-material prices remains substantially the same, although there were numerous fluctuations due to seasonal local labor and transportation influence.

Book Reviews

THE OUTLINE OF ART, A GUIDE TO THE GREAT ART TREASURES OF THE WORLD. With more than 300 illustrations. Including 24 full-page plates in color. Edited by Sir William Orpen, K. B. E., R. A. R. I. In two volumes. Vol. I. G. P. Putnam's Sons, New York and London.

In these days of much hurry and little time for the extended study of any of the arts, a book of this kind, that gives a comprehensive review of the story of art, illustrated with reproductions of many of the world's masterpieces, is a welcome addition to any library. We are living in an age of outlines, and we are fortunate when we can have our art put before us in such an attractive and beguiling form. The illustrations are excellent, and by means of them we are permitted to visit some of the famous galleries of the world.

In this new addition to the "Outline" series there is no attempt to cover all the details of the history of art or to indulge in learned argument or criticism. The main purpose is to reproduce as many as possible of the greatest pictures in the world and to say enough about their painters for the reader to understand what are their peculiar characteristics and what are the qualities of the work that make it beautiful and inspiring.

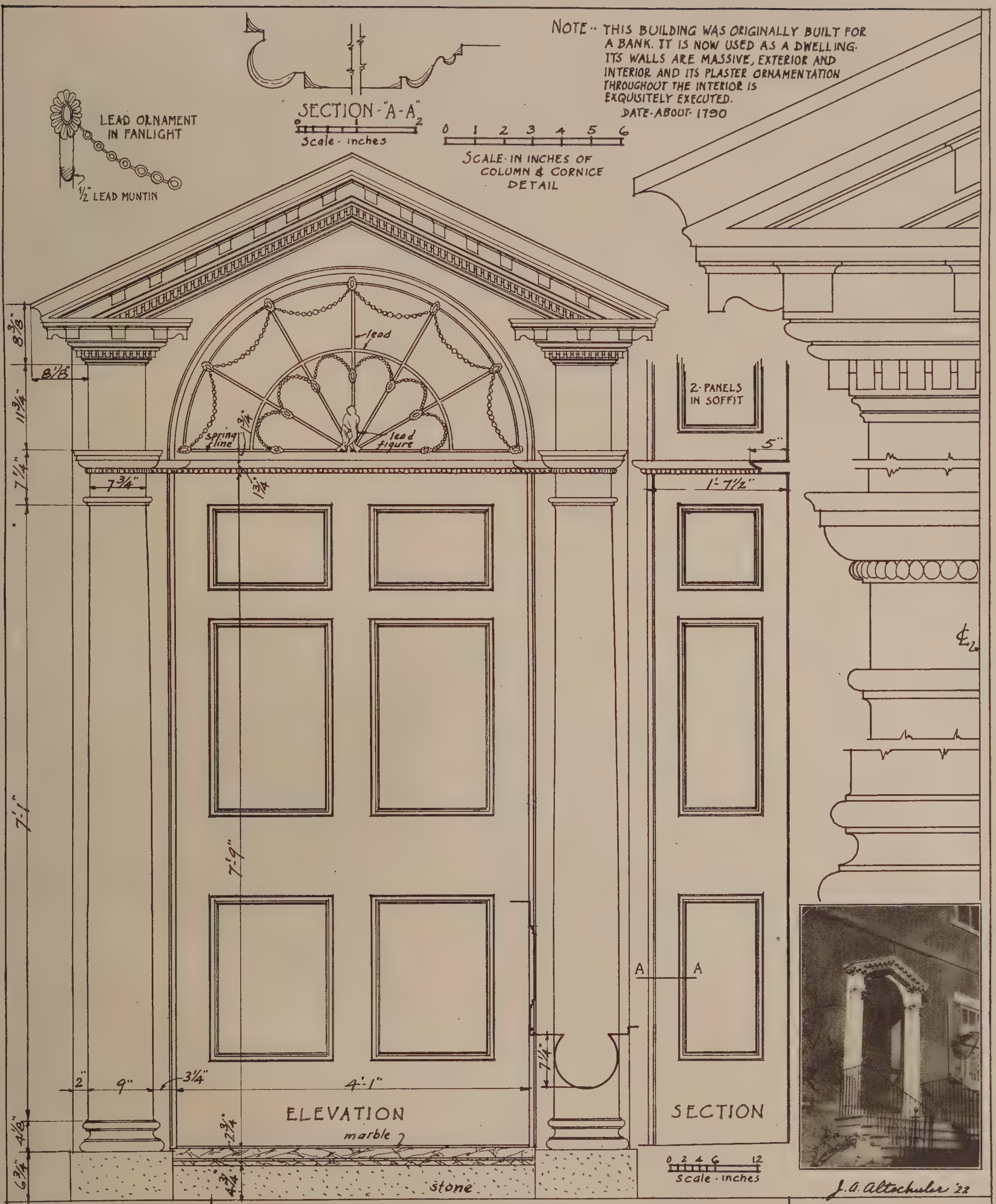
"The Outline of Art" is not intended for the critic and the expert, but rather for the general public wishing for guidance to the great art treasures of the world; it gives a clear and concise view of the work of the great masters and the essentials of present-day art.

D'ESPOUY: ONE HUNDRED SELECTED PLATES FROM "FRAGMENTS D'ARCHITECTURE ANTIQUE." The Library of Architectural Documents. Vol. II. The Pencil Points Press, Inc., New York.

It was a happy thought to reprint this famous work, and students will welcome it. The original work was in two volumes, made up of drawings by winners of the Grand Prix de Rome during their studies at the French Academy in Rome. The value of the work as a reference on the masterpieces of antiquity is recognized by architects and teachers everywhere. The plates are well printed and preserve the qualities of the originals.

OVER THE DRAWING BOARD. A DRAFTSMAN'S HAND BOOK. By Ben J. Lubschez, F. A. I. A. Second edition, revised. Press of the American Institute of Architects, New York.

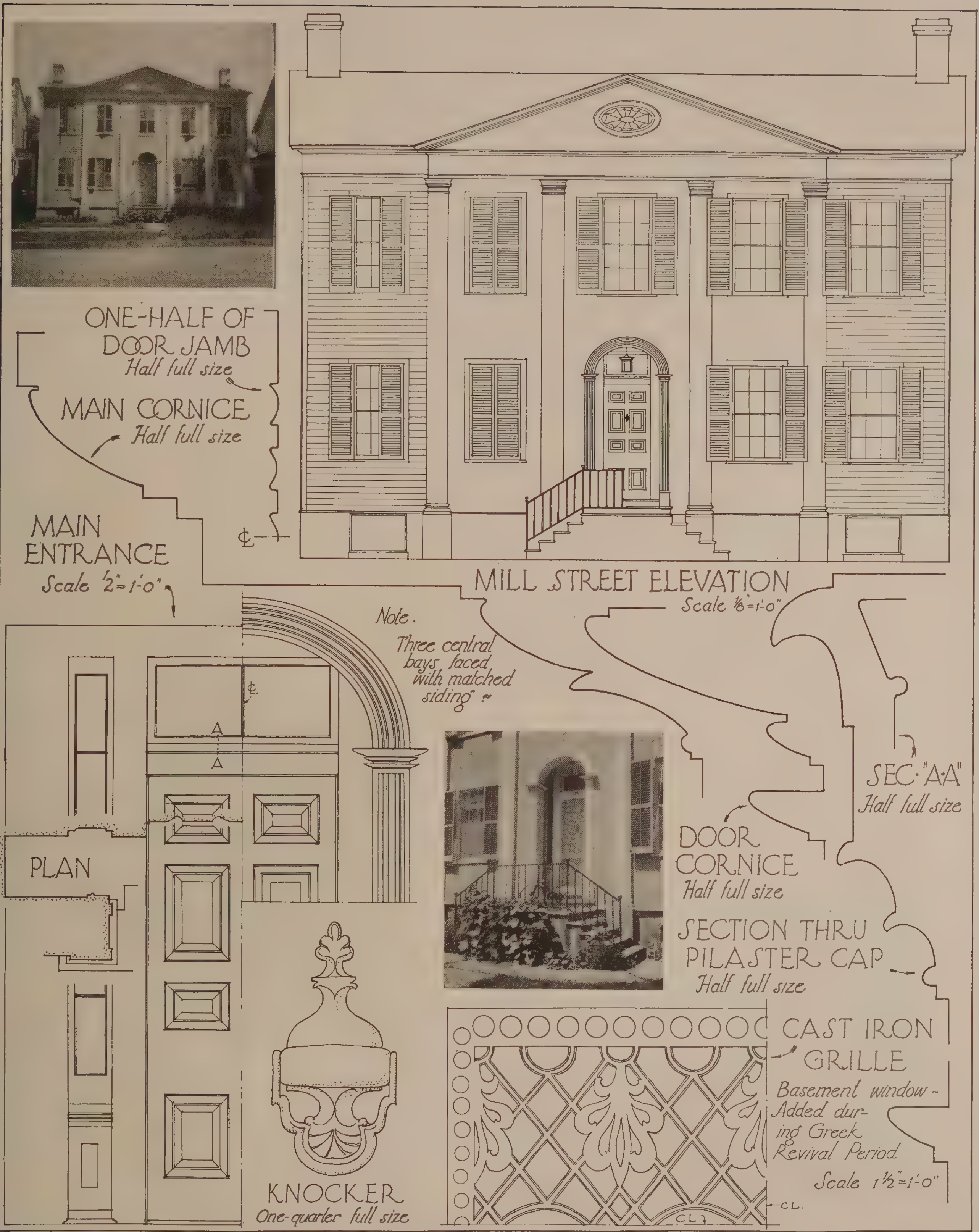
As Mr. Magonigle said in a review of this useful little book, "Mr. Lubschez has remembered the little things, and this is one of the chief virtues of the book. It should be in the hands of all students and draftsmen."


NOTE.. THIS BUILDING WAS ORIGINALLY BUILT FOR A BANK. IT IS NOW USED AS A DWELLING. ITS WALLS ARE MASSIVE, EXTERIOR AND INTERIOR AND ITS PLASTER ORNAMENTATION THROUGHOUT THE INTERIOR IS EXQUISITELY EXECUTED.
DATE-ABOUT-1790

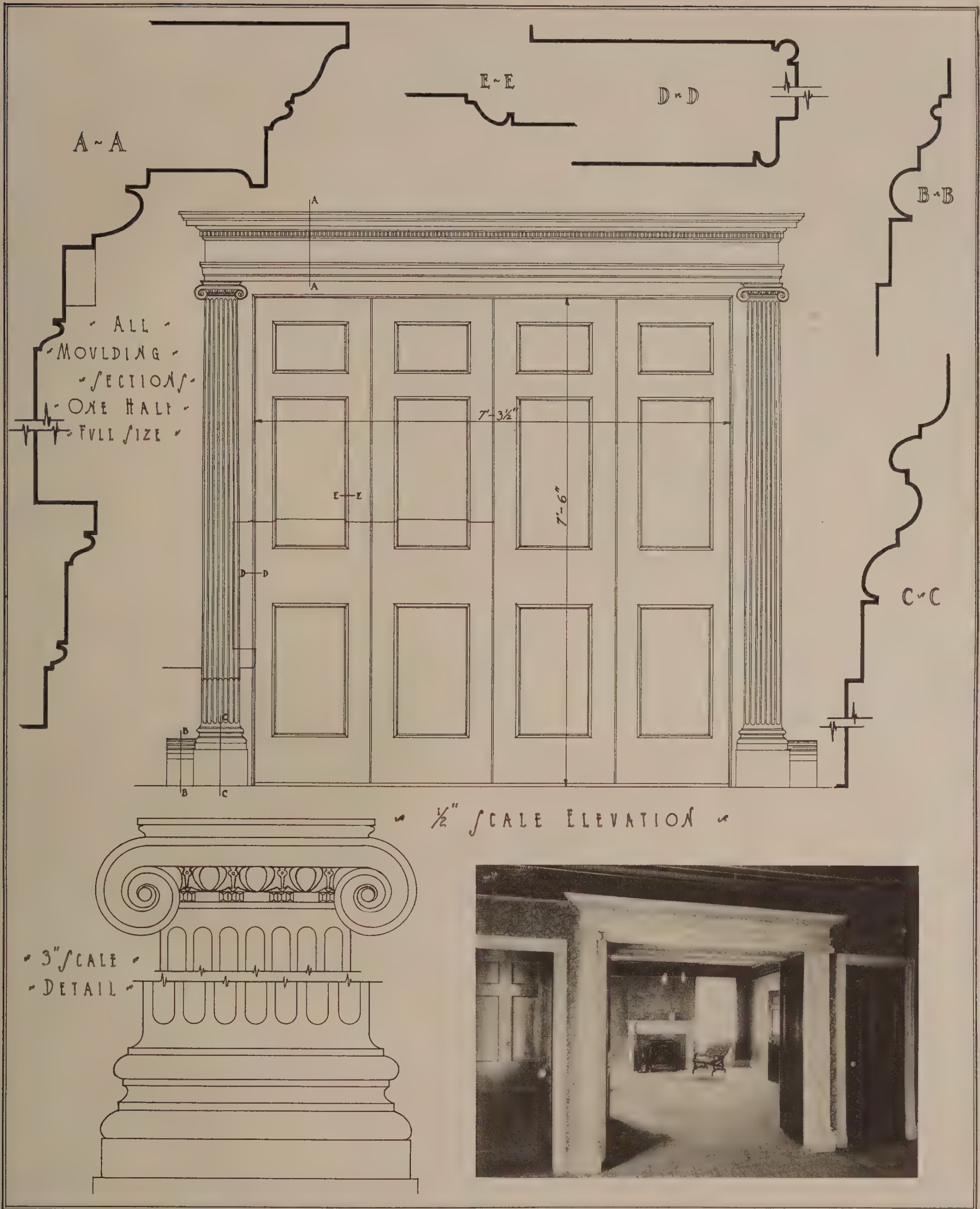
EARLY COLONIAL ARCHITECTURE of the CAROLINA S'

DOORWAY of an old BANK
Nº 54 CRAVEN ST., NEW-BERN-N.C.

MEASURED & DRAWN. by J.A.ALTSCHULER



EARLY ARCHITECTURE OF CENTRAL NEW YORK	THE GEORGE HOUSE ORIGINALLY BANK OF NEWBURGH MILL STREET · ITHACA · N · Y ·	MEASURED & DRAWN BY CHAS. M. STOTZ

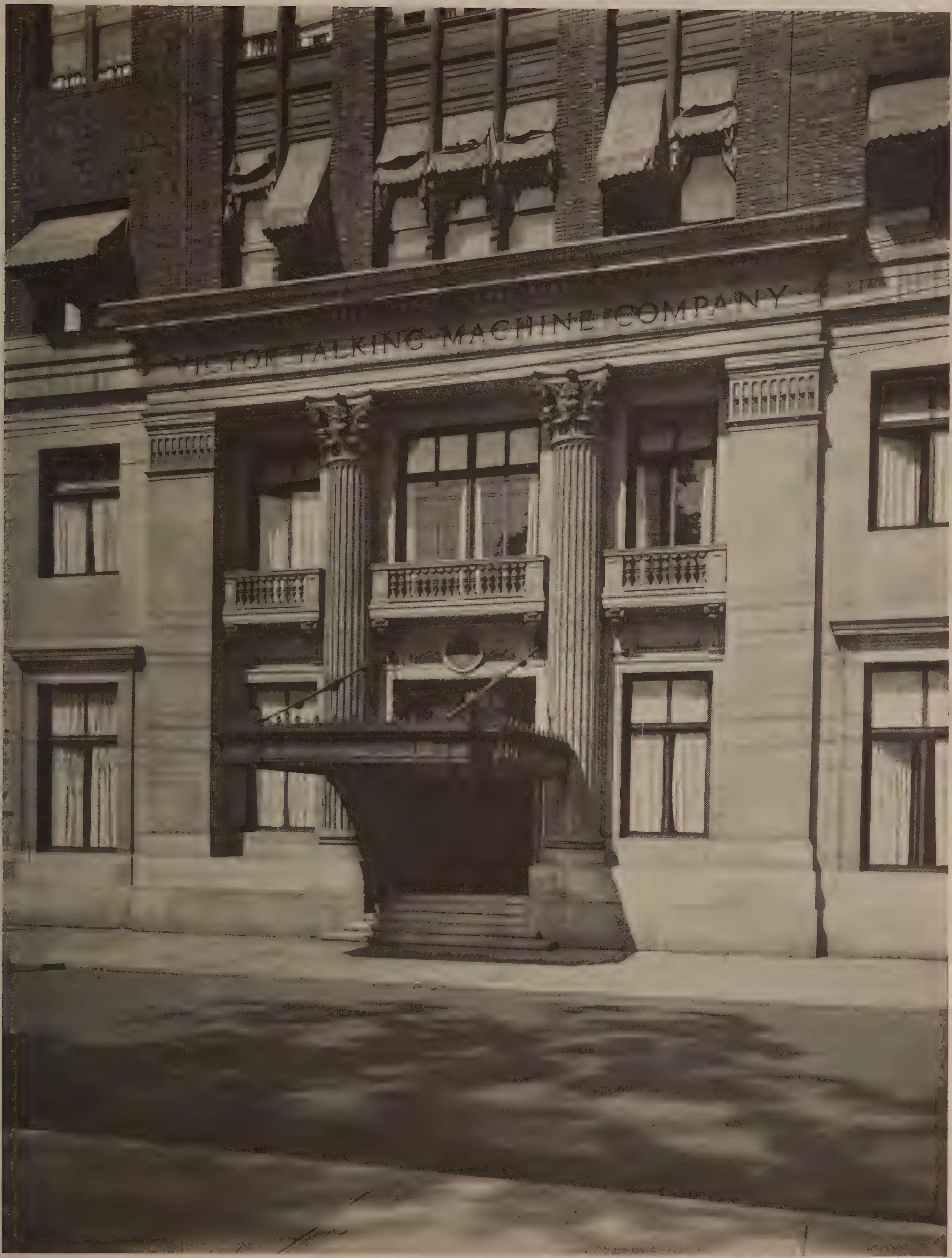


EARLY ARCHITECTURE OF CONNECTICUT

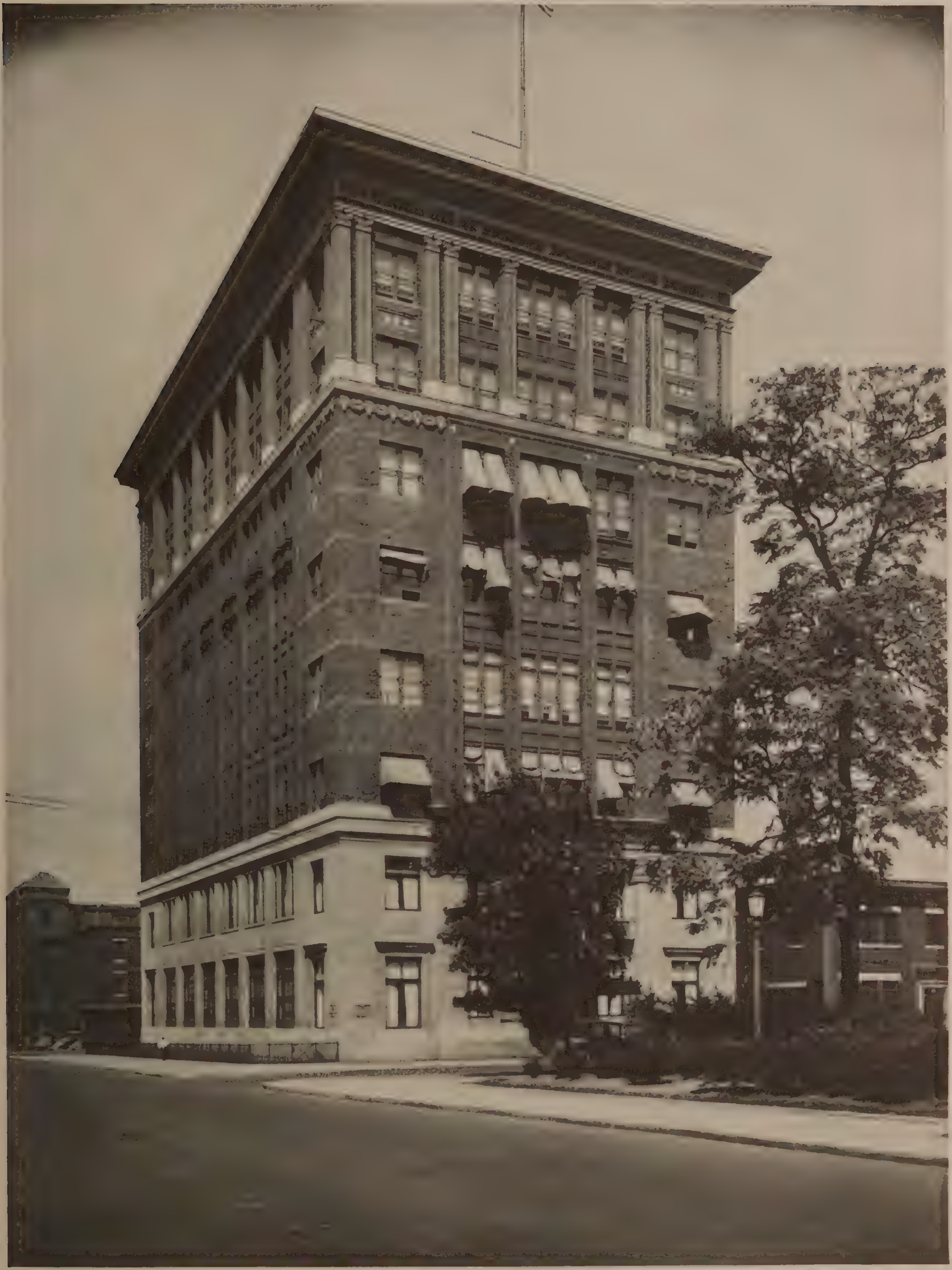
INTERIOR DOORWAY

IN AN OLD HOUSE #361 TEMPLE ST., NEW HAVEN, CT.
DAVID HOADLEY ARCHITECT

MEASURED BY J. FREDERICK KELLY
DRAWN BY HENRY S. KELLY



DETAIL OF ENTRANCE, GENERAL OFFICES, VICTOR TALKING MACHINE CO., CAMDEN, N. J.
Walter T. Karcher and Livingston Smith, Architects.



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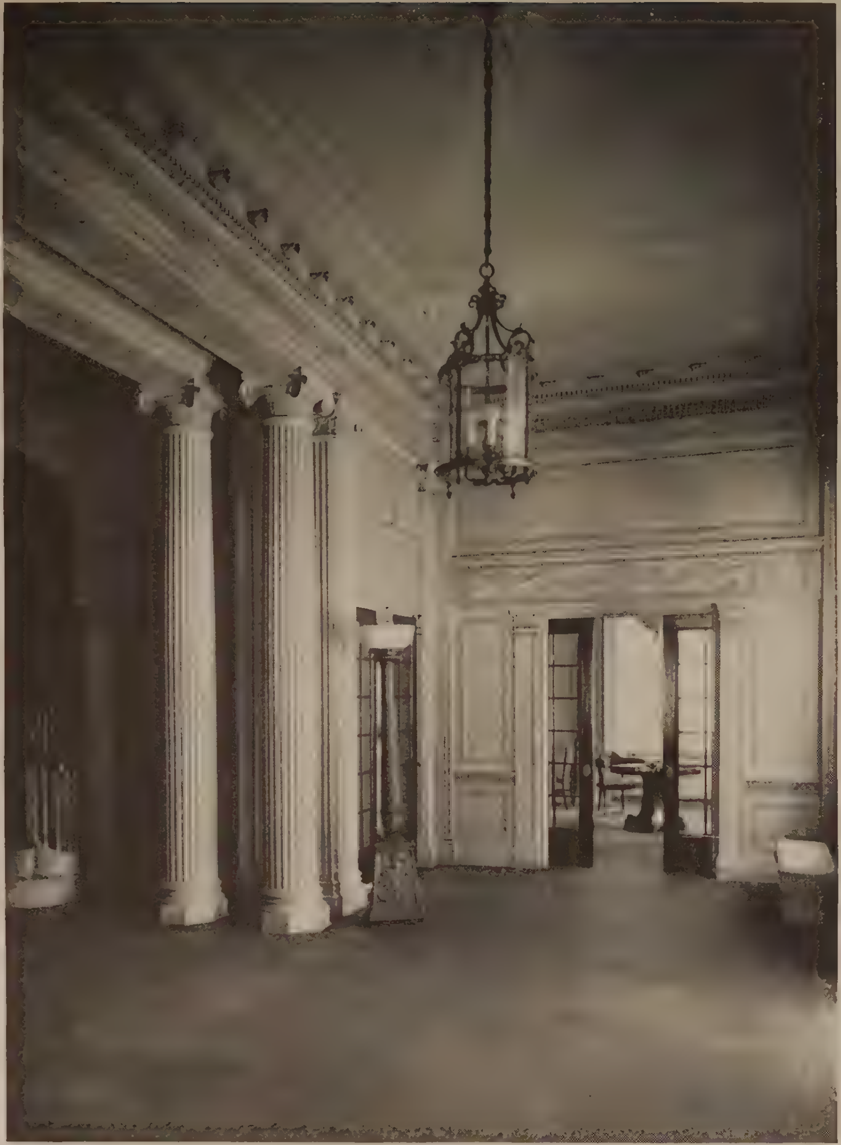
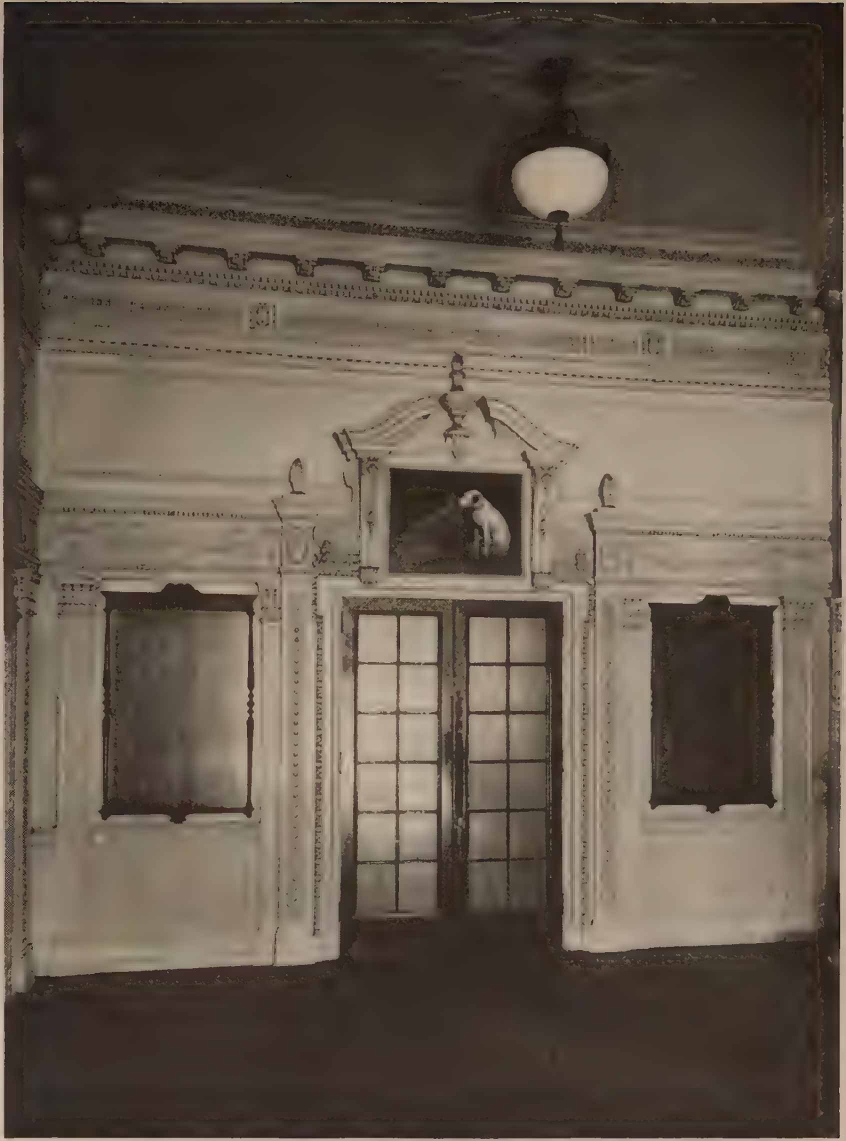
Walter T. Karcher and Livingston Smith, Architects.



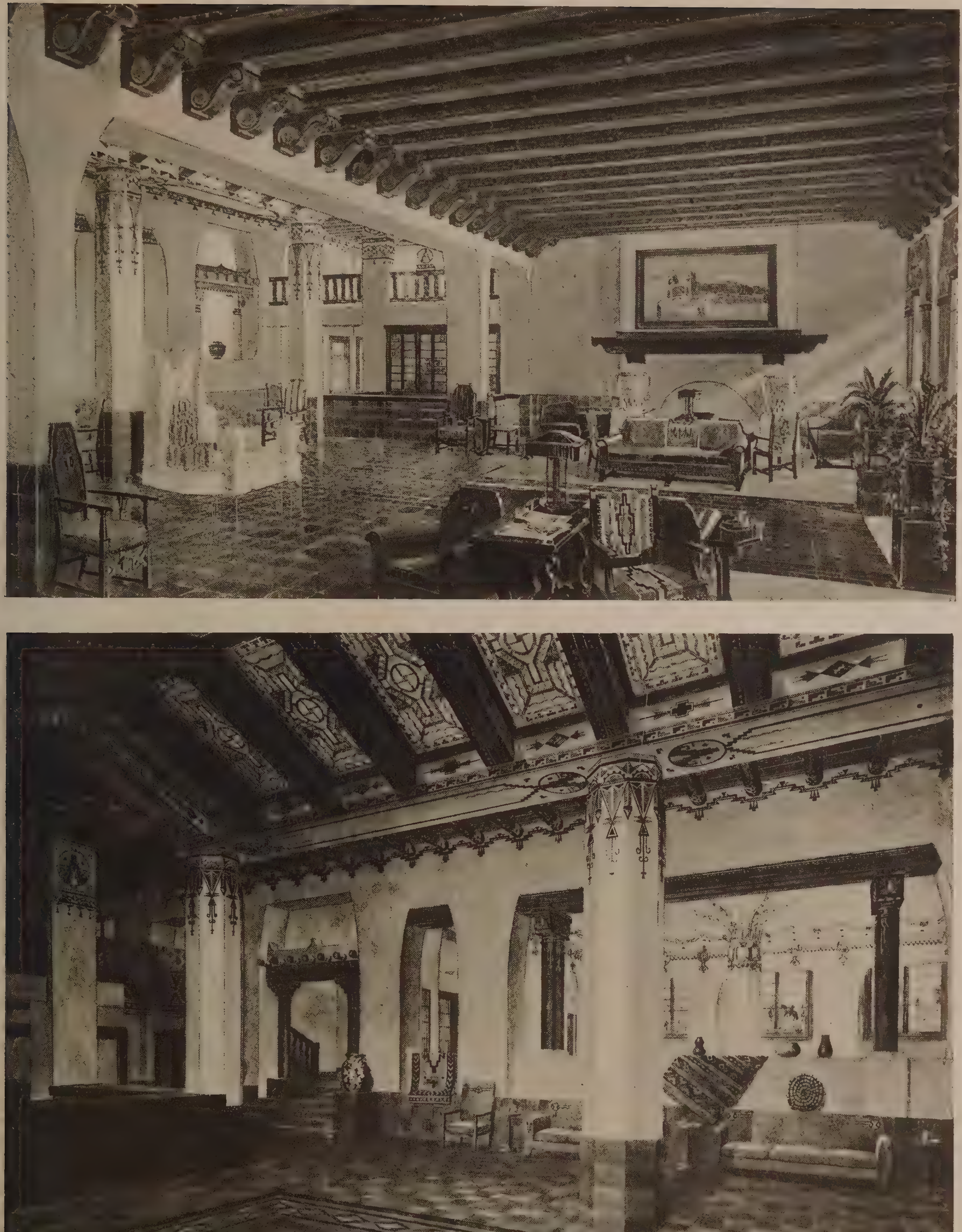
GENERAL VIEW OF FIRST-FLOOR ENTRANCE LOBBY.



DETAIL, DOORWAY IN FIRST-FLOOR LOBBY, SHOWING BRONZE AND BRASS MEMORIAL TABLETS.

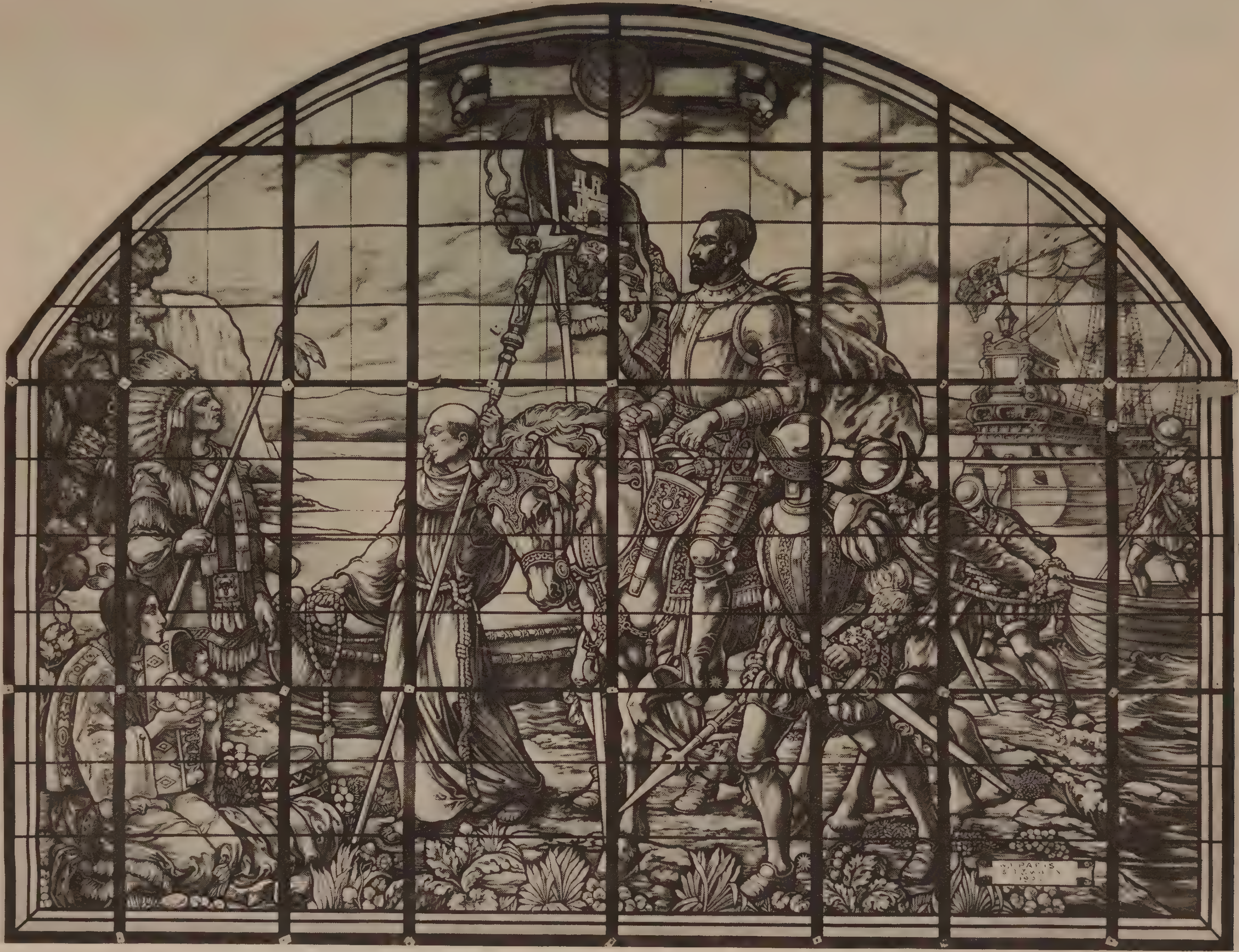
GENERAL OFFICES, VICTOR TALKING MACHINE CO., CAMDEN, N. J.

Walter T. Karcher and Livingston Smith, Architects.

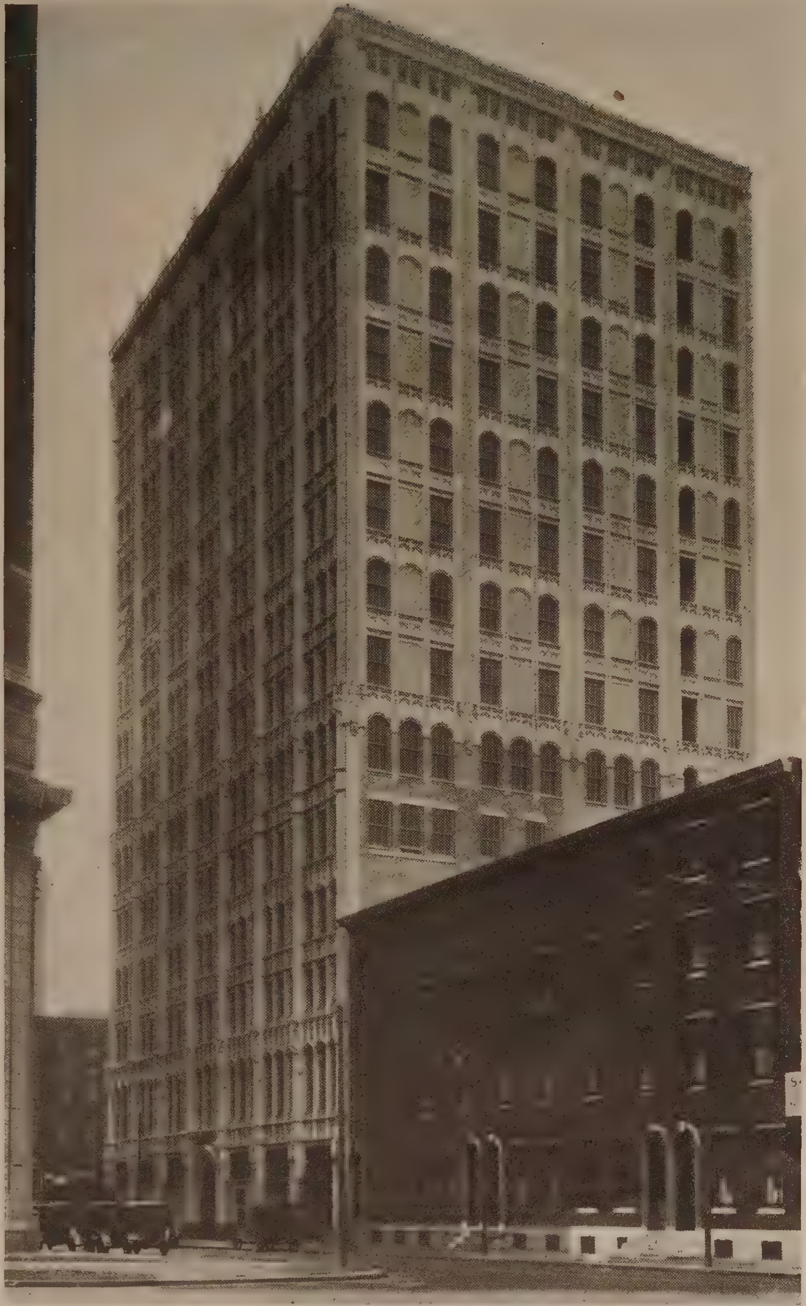


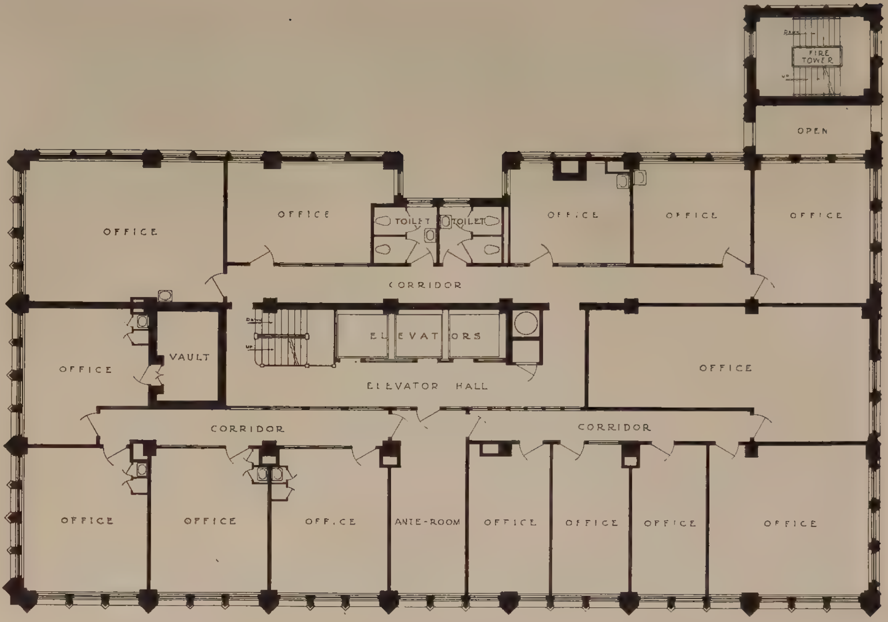
LOBBY, FRANCISCAN HOTEL, ALBUQUERQUE, N. M.

Trost & Trost, Architects.

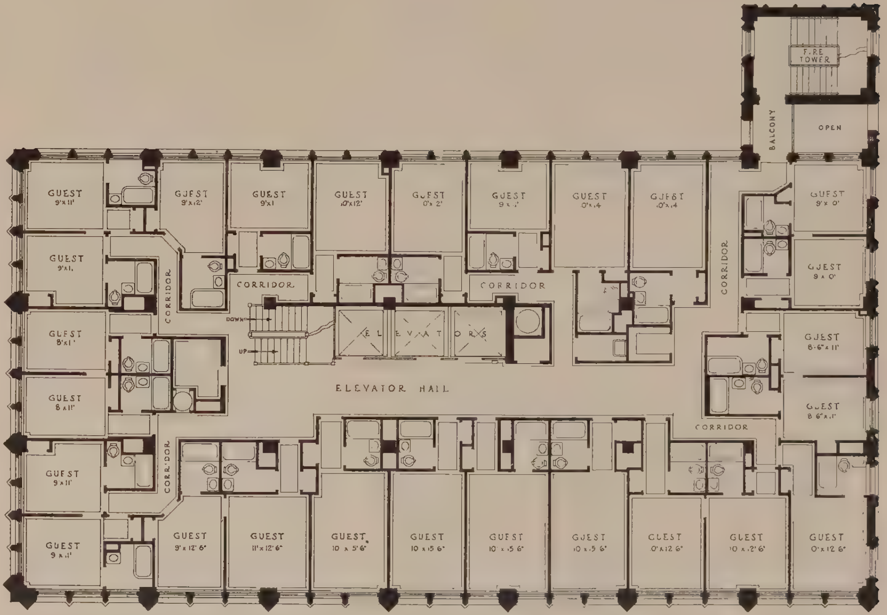


PAINTED GLASS WINDOW FOR SENATE ROOM, MISSOURI STATE CAPITOL, JEFFERSON CITY, MO.
The work of Fred'k J. Wiley and W. Francklyn Paris.
Egerton Swartwout, Architect.





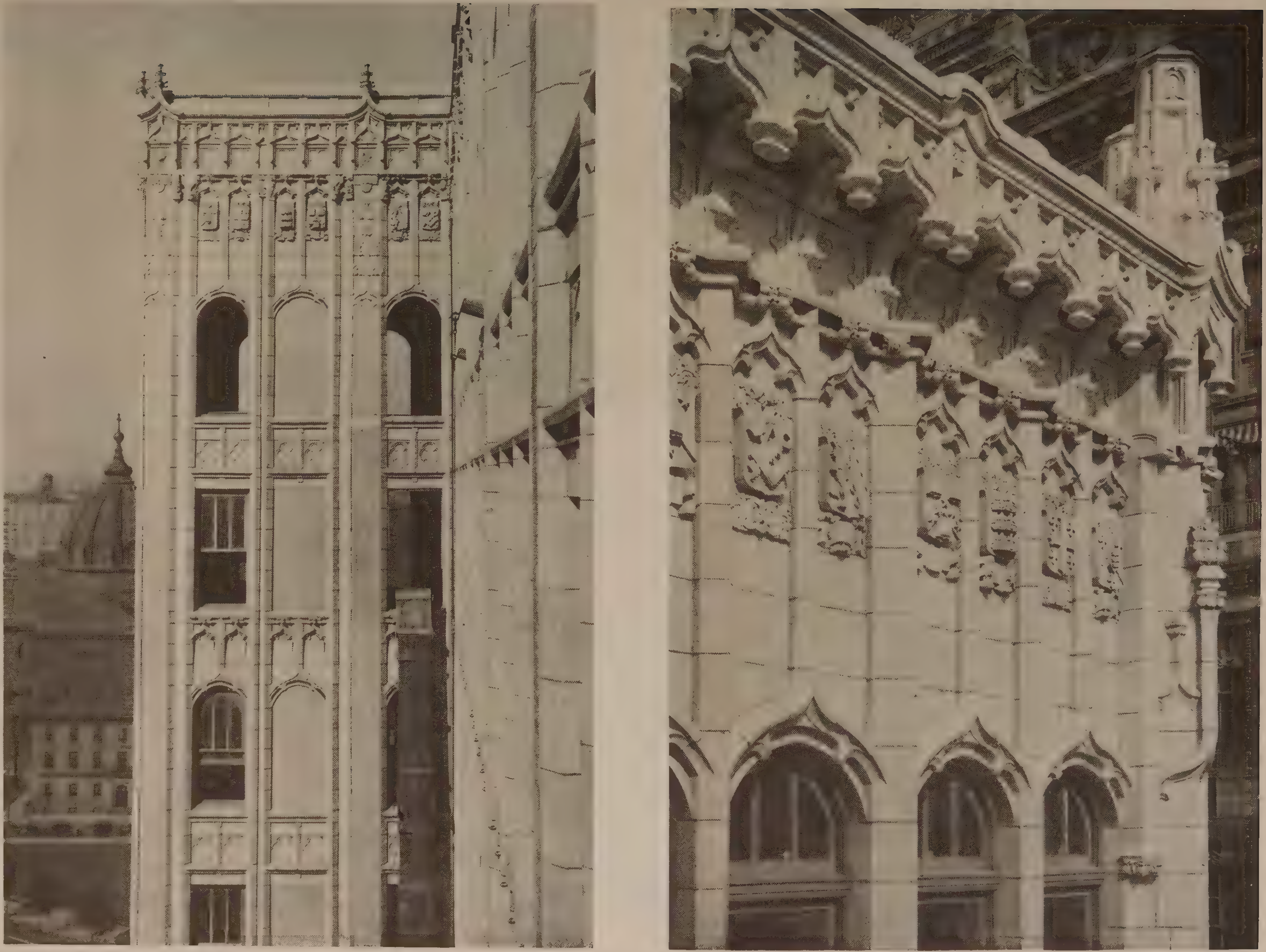
TYPICAL OFFICE FLOOR PLAN



TYPICAL BED ROOM FLOOR PLAN · 7TH TO 14TH FLOORS INC.

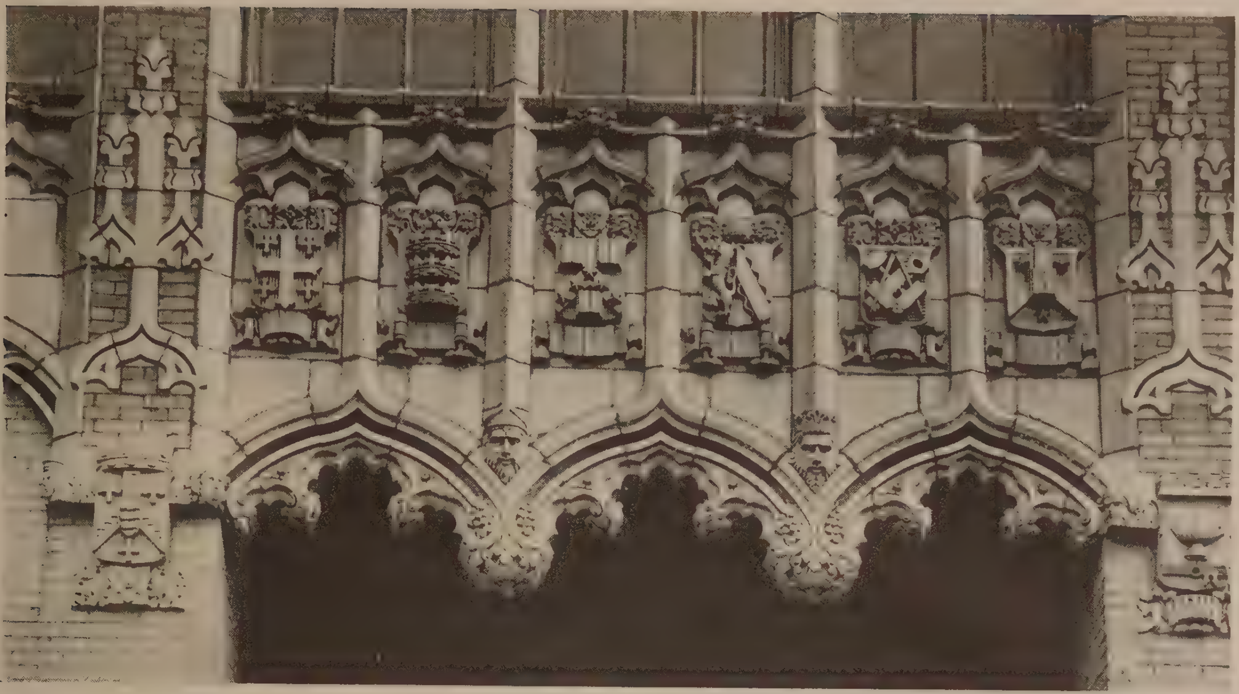
WESLEY BUILDING AND ROBERT MORRIS HOTEL, PHILADELPHIA, PA. (ALTERATION AND ADDITION.)

The Ballinger Co., Architects and Engineers.

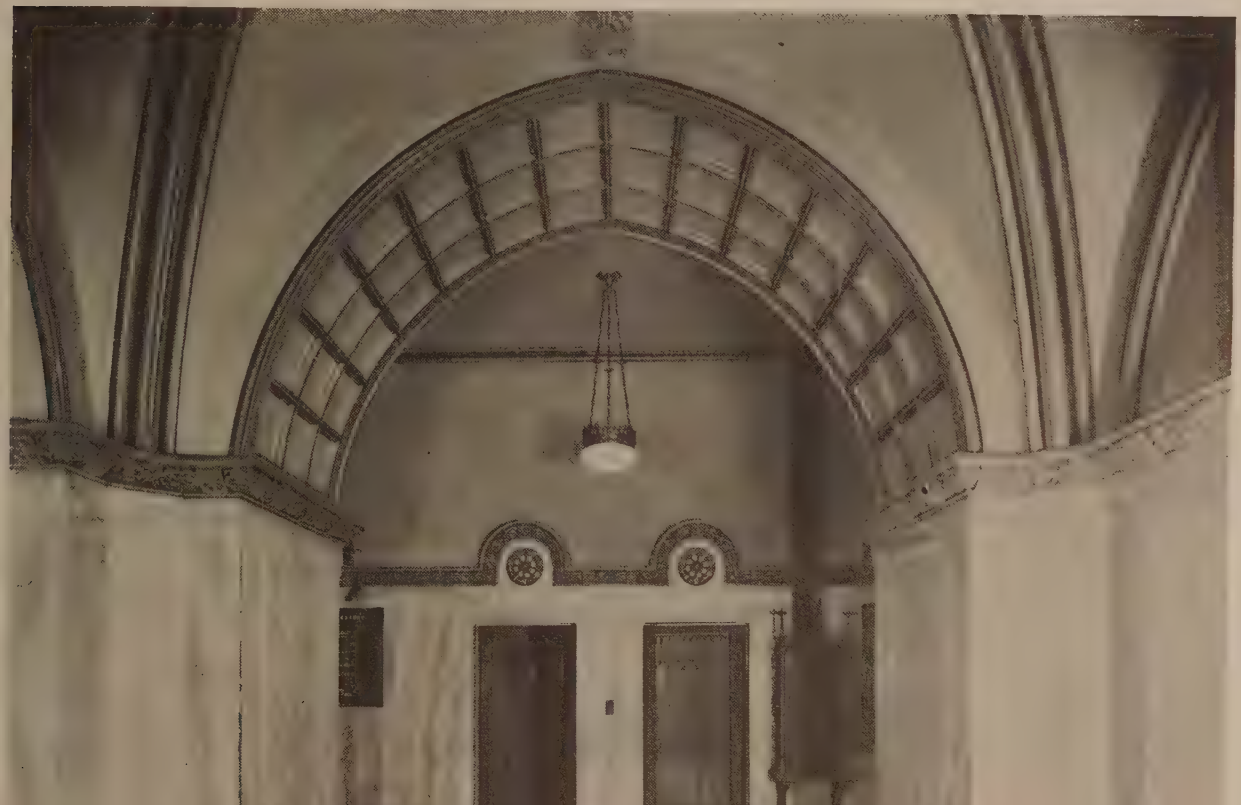


TERRA-COTTA DETAILS, WESLEY BUILDING AND ROBERT MORRIS HOTEL, PHILADELPHIA, PA.

The Ballinger Co., Architects and Engineers.



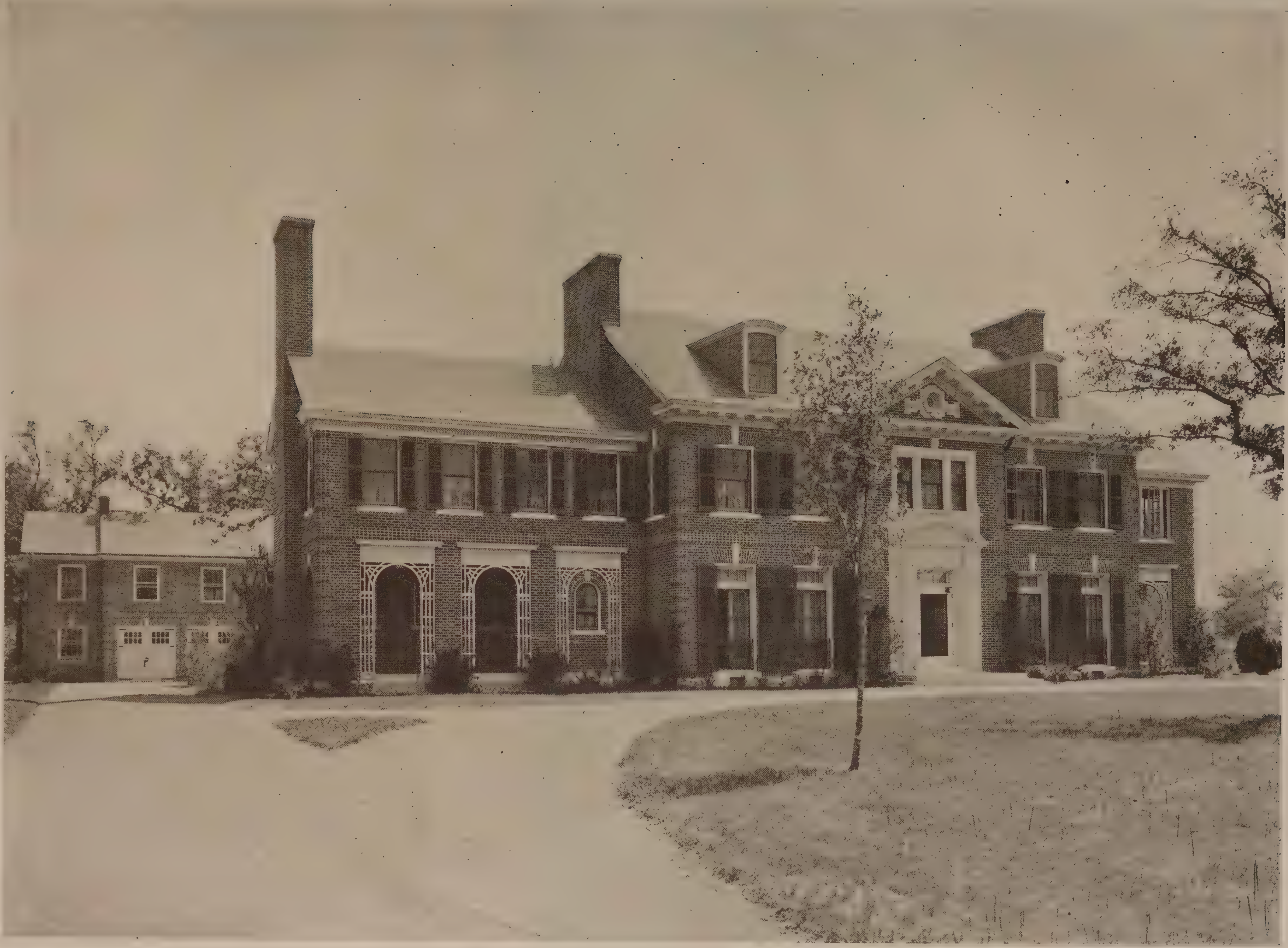
TERRA-COTTA DETAIL.



ELEVATOR LOBBY.

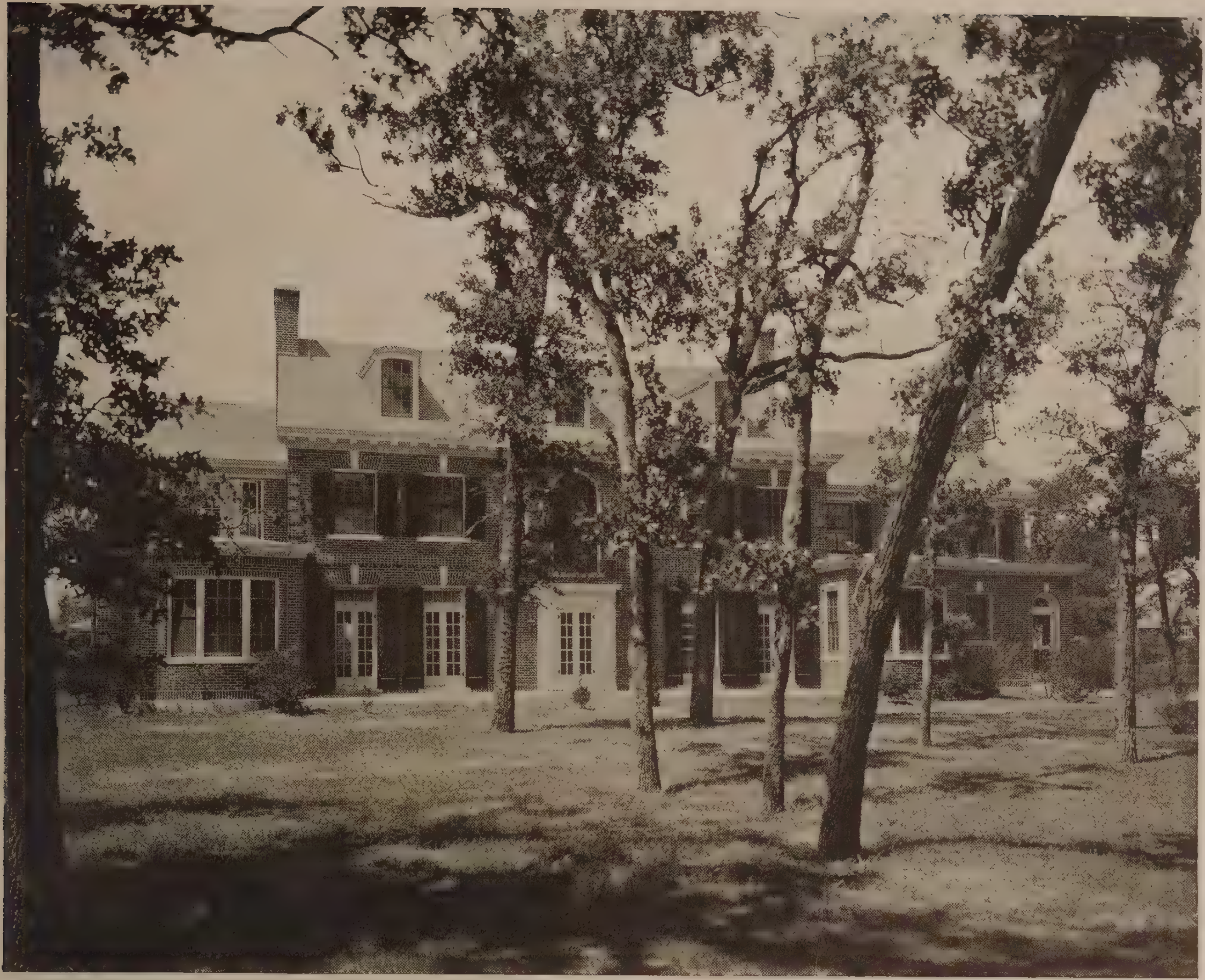
Ballinger & Co., Architects and Engineers.

WESLEY BUILDING AND ROBERT MORRIS HOTEL, PHILADELPHIA, PA.

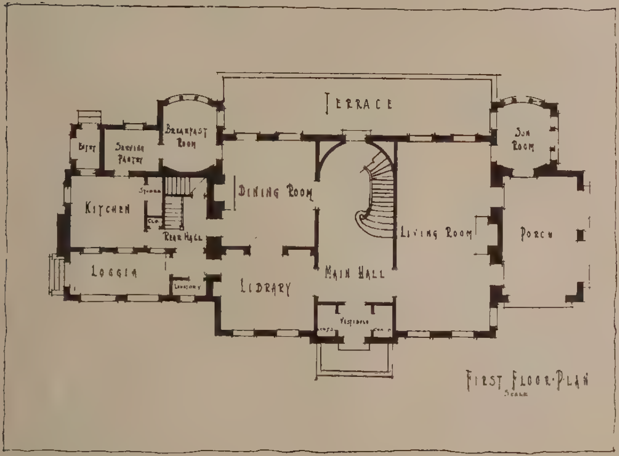


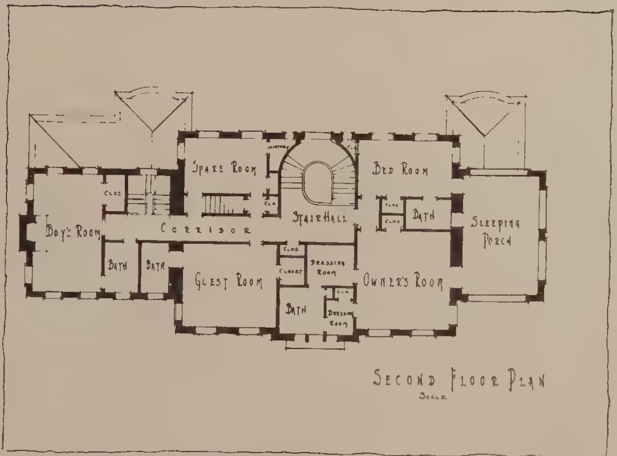
FRONT, RESIDENCE IN HOUSTON, TEXAS.

Briscoe & Dixon, Architects.



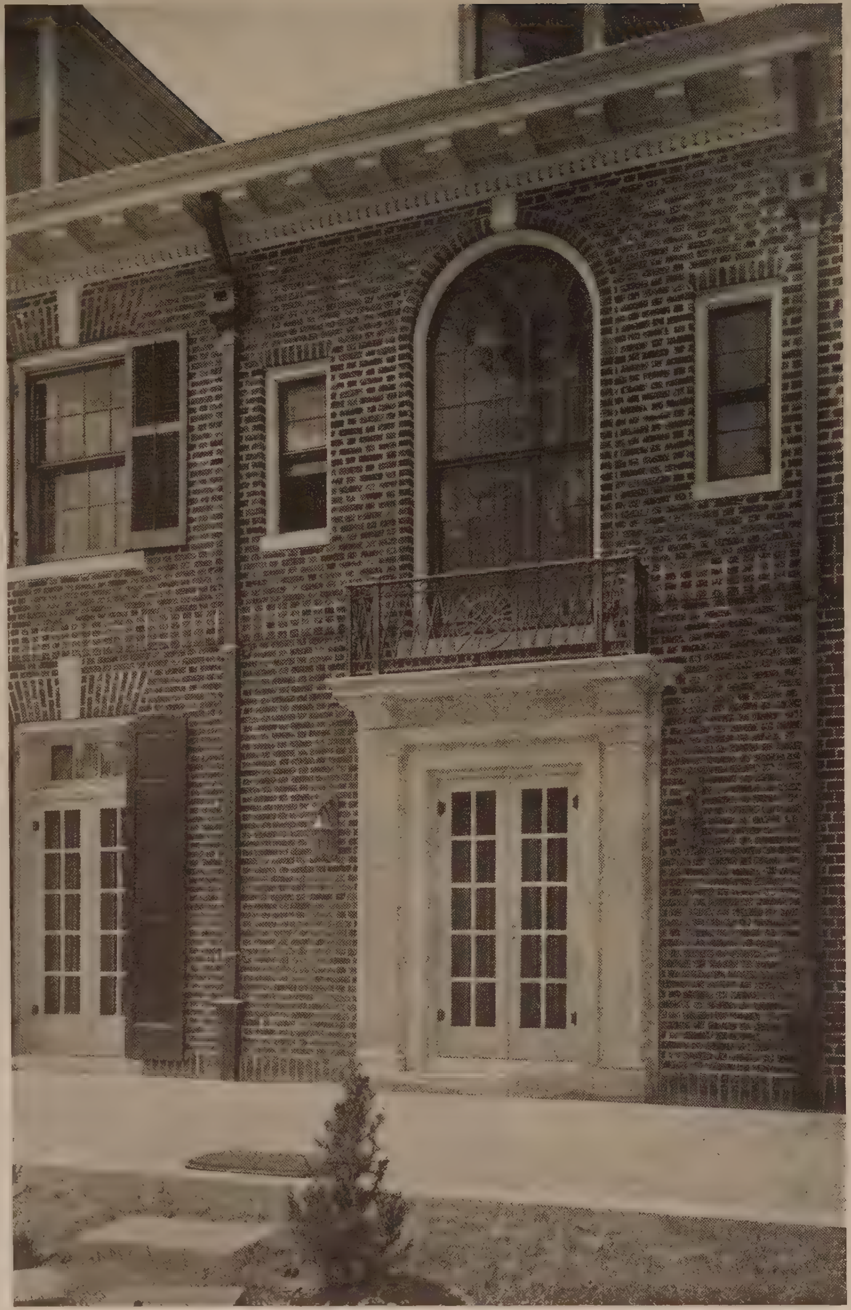
GARDEN FRONT.



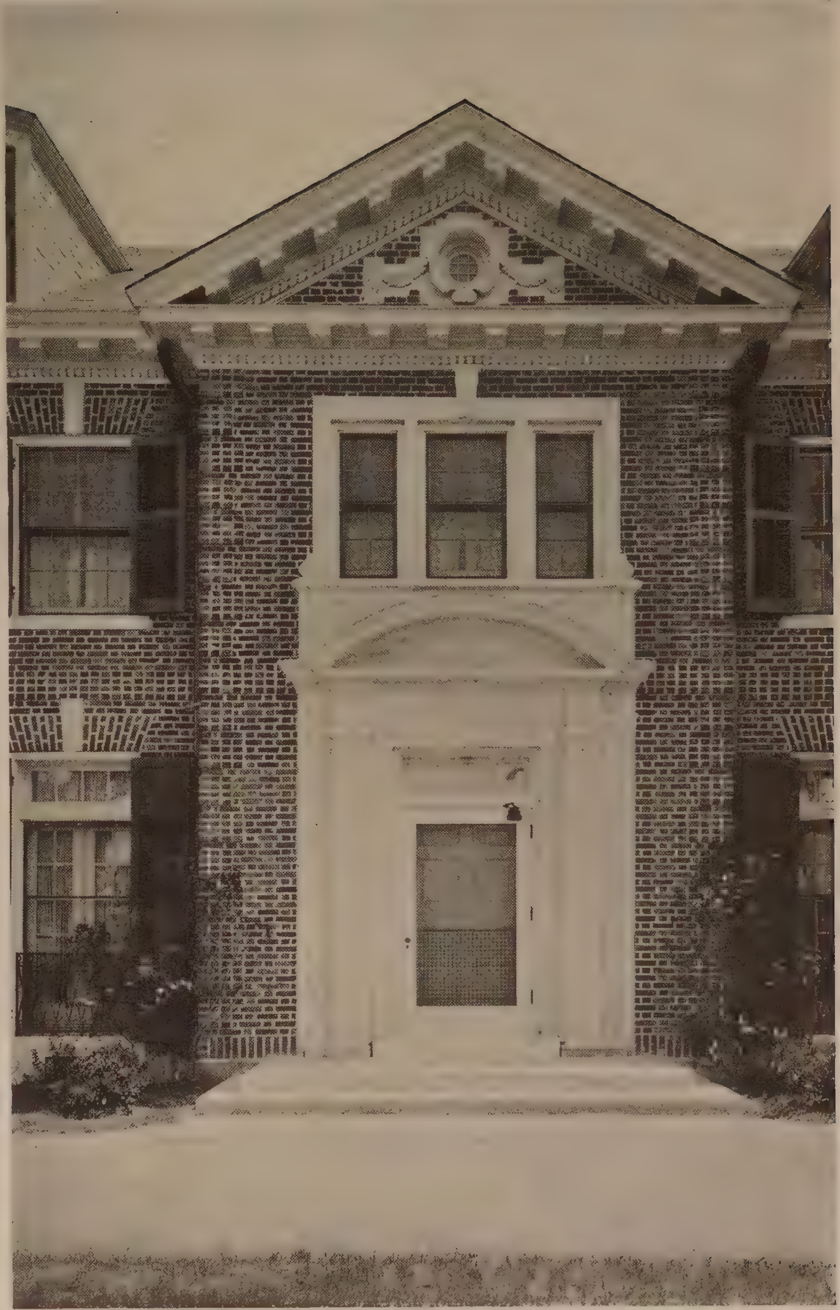


RESIDENCE IN HOUSTON, TEXAS.

Briscoe & Dixon, Architects.

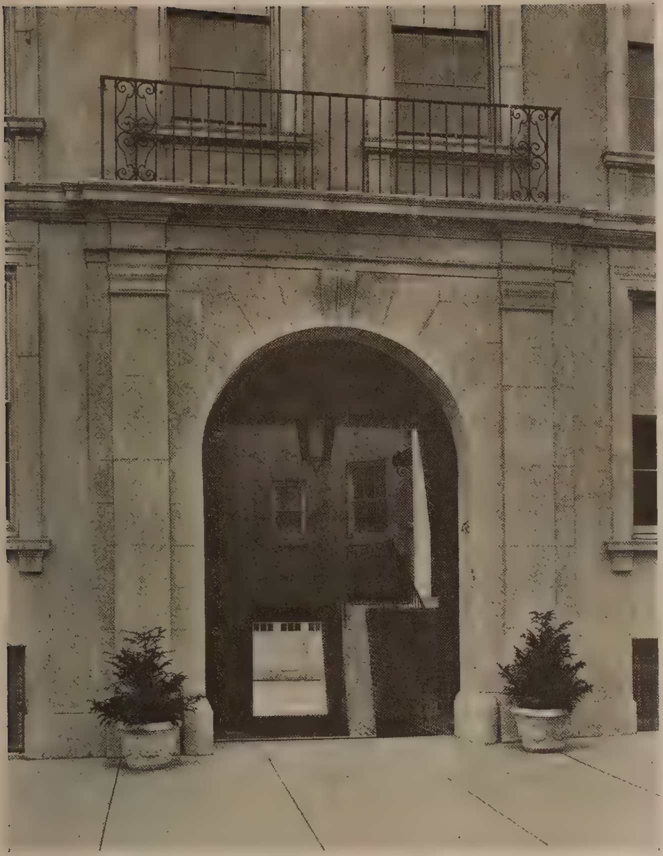


REAR TERRACE ENTRANCE DETAIL.

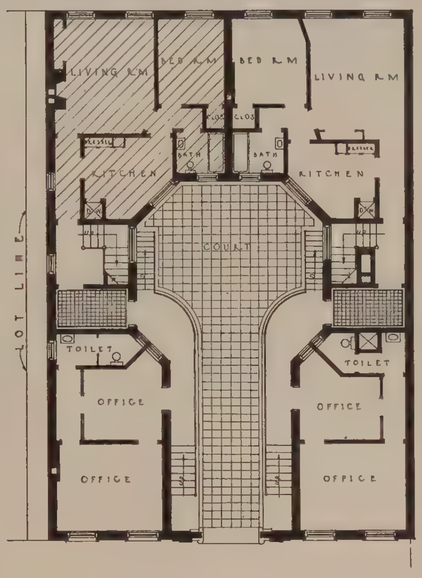


FRONT ENTRANCE DETAIL.

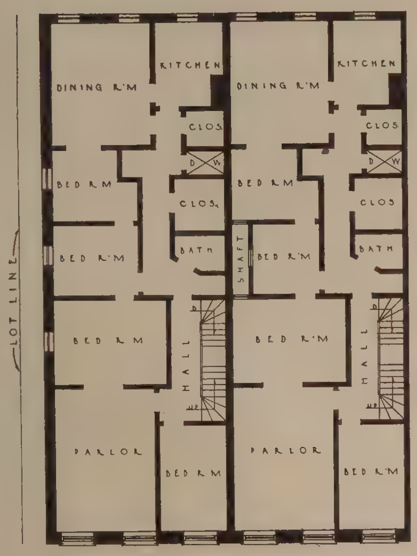
RESIDENCE IN HOUSTON, TEXAS.
Briscoe & Dixon, Architects.



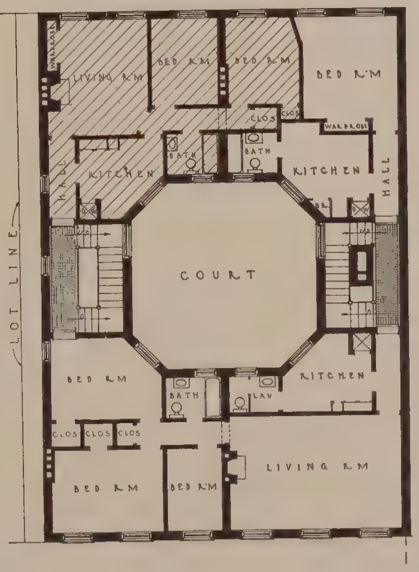
MAIN ENTRANCE TO COURT.



FIRST FLOOR PLAN
436-438 E. 57TH ST NEW YORK CITY
W F THOMPSON ARCHITECT, NEW YORK CITY
SCALE



TYPICAL FLOOR PLAN BEFORE ALTERATION
436-438 EAST 57TH STREET NEW YORK CITY
SCALE



TYPICAL FLOOR PLAN
436-438 E 57TH. ST. NEW YORK CITY
W F THOMPSON ARCHITECT NEW YORK CITY
SCALE

APARTMENT-HOUSE, EAST 57TH STREET, NEW YORK (ALTERATION). Wm. F. Thompson, Architect.

Construction of the Apartment-House

By H. Vandervoort Walsh

Instructor of Construction, School of Architecture, Columbia University, New York

ARTICLE XI

Analysis of the Typical Steel Frame

THE backbone of the modern fireproof apartment is the steel frame, a cage-like construction which must be protected from the weather and any accidental fire. The steel columns are designed to carry the floors and the exterior walls. No walls or partitions carry any loads. Exterior walls are supported at each floor on wall girders which the columns carry. Interior partitions of hollow blocks are built directly on top of the reinforced-concrete floor-slabs, and their weight is thus distributed over the steel floor-beams.

When a building of this type is in the process of erection each floor is clearly seen to be an independent horizontal level, upheld by the columns. I-beams, spaced about 8 feet apart, support reinforced-concrete slabs 4 inches thick between them. These I-beams are, in turn, supported by girders between columns, and so the load of the floor is transferred to the columns.

The wall girders, which span from column to column in the plane of the wall, are covered with concrete, making a rough rectangular beam when the forms are removed. On top of each wall girder at each floor is built the exterior wall. The face brick or the stone ashlar, 4 inches in thickness, is carried up outside of the line of wall girders, and receives no direct support from the steel other than that it is bonded into the wall. As the back-up of the wall is usually hollow terra-cotta tile or hollow brick, about 8 inches thick, we have the phenomenon of a thin 12-inch wall enclosing the structure from the ground to the roof.

As most of these apartments are erected as investments, those which can show the greatest economy of construction costs are the most successful. Everything is done to minimize the quantity of steel and masonry necessary to enclose the livable floor area. Walls and partitions are made as thin as possible. But in recent years the most important change that has taken place is the lowering of the story heights, so that steel columns and walls may be reduced. It was customary to build the first-class fireproof apartments with 12-feet, or even 13-feet, story heights. To-day, however, it is a rare thing to find an apartment of this type having story heights of more than 10½ feet.

This extraordinary shrinkage has brought about a very distinct type of steel frame for buildings of this kind, a type quite different from any office-building or hotel. Even low floor levels make it very difficult to arrange the steel floor-beams so that they will not interfere with the ceilings or headroom. Take, for example, a 15-inch I-beam used for a girder. The distance to the finished floor above this would be 4 inches. The fireproofing below the soffit would be 1½ inches to 2 inches, and the plaster an inch. This makes a total of 22 inches below the floor level, or a clearance beneath the girder of 8 feet 8 inches. The tenement-house law and custom would not permit the ceiling to be furred down to this level, and therefore any girder of this depth will be in the way when a ceiling of a room is plastered. Now, the level of the plaster ceiling is usually made about 9 inches or 10 inches below the level of the finished floor in order to give as great a height from floor to ceiling as possible. This would make a 15-inch I-girder, fireproofed and plastered, extend down 1 foot below the ceiling level; a 12-inch I-girder 9 inches below; and an 8-inch I-beam 3 inches below. In some cases, where the fireproofing and plaster covering on the soffits were specially thin, we have seen these beams and girders project below the plaster ceiling an inch less than the figures just quoted.

But it is evident that unless these beams are related to the rooms they will seriously mar the appearance of the ceiling. It would not be possible to have a very elegant living-room or dining-room if the girders and beams ran across the ceiling in any old way.

Yet if we should build the steel frame in a straightforward fashion, as is usual with office-buildings, placing columns at regular intervals to form rectangular bays, then girders and beams would extend over the ceilings of the room without any relation to their shapes.

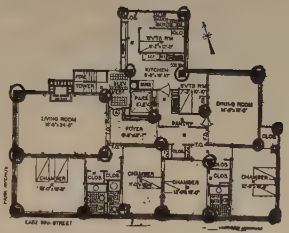
In one of the illustrations we have shown two typical bays of regular arrangement. The interior columns line up with the columns in the exterior walls. Girders run, as they should, at right angles to the wall, and floor-joists are standardized to one size. This would be an ideal arrangement as far as the steel is concerned, but it does not work out with the average apartment. We have seen non-housekeeping apartments use a steel frame of this kind, for the rooms are more or less regular, tending toward the hotel plan. But if we examine the plan of the usual apartment it will be found that if the steel plan were laid out in this regular way, the beams and girders would produce all kinds of irregular panels on the ceilings of the various rooms.

Therefore there is only one thing to do: make the girders and beams conform to the plan of the apartment. Girders must be placed over partitions, and floor-joists symmetrically placed across the ceiling of the rooms. Even when the girders are arranged over the partitions, they project awkwardly into the room, and the plaster must be carried around them in the way shown by the drawings.

This forcing of the steel plan to fit the room arrangement gives the engineer quite a puzzle. Columns on the interior are rarely in line with those on the exterior, for they have to be put in where they are least objectionable. Girders are framed to the columns, sometimes at the side, sometimes on centres, sometimes to other short girders placed between two columns. Joists are spaced this way and then that way, so that they will appear symmetrical with the rooms and halls.

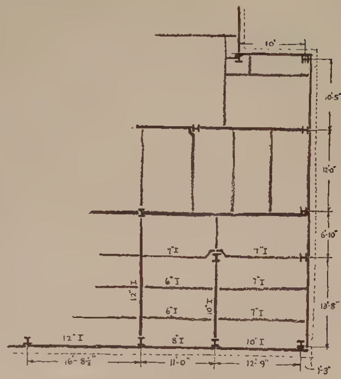
It would be an almost impossible task to pick up the plan of the average apartment and, knowing the position of columns, figure out the floor framing. We could guess one for ourselves, but to guess the one that the engineer used would be taking a big chance, so complicated are they.

But there are certain principles which we can notice. As far as possible floor-beams are set across spans 12 feet or less, and spaced from 5 feet to 8 feet on centres, so that 6-inch, 7-inch, and 8-inch I-beams may be used. An effort



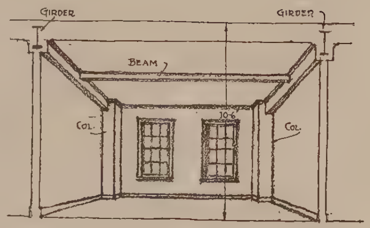
Plan Shows How Columns Are Spaced In A Very Irregular Way To Permit Girders To Come In Line With Partitions

3



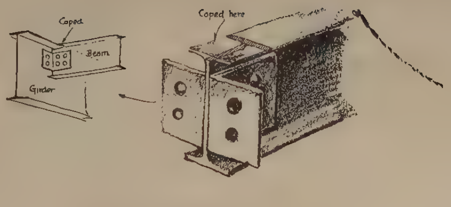
Sketch Showing Compicated Floor Framing At One Corner Of Building

2.



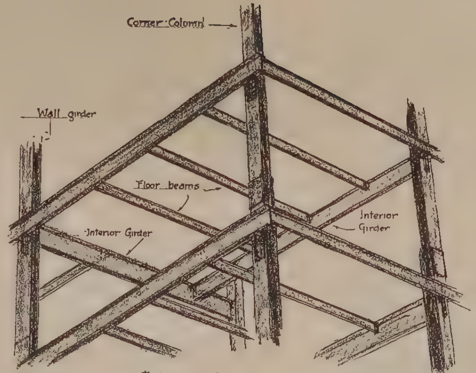
How The Low Story Height Forces The Steel Frame To Conform To The Room Layout

1.



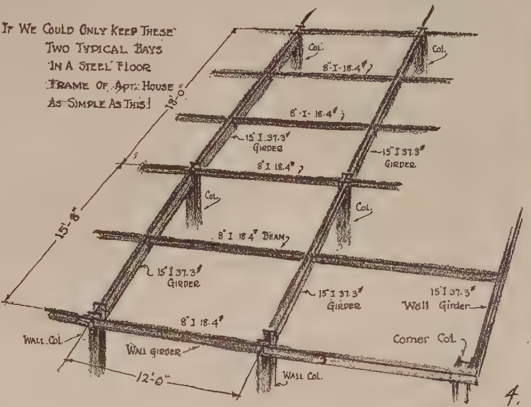
Connection Between Beam And Girde

6.



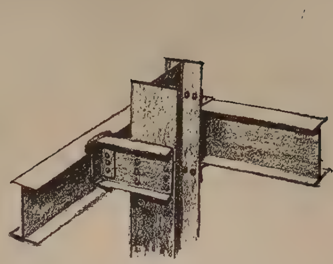
— Frame at Corner —

5.



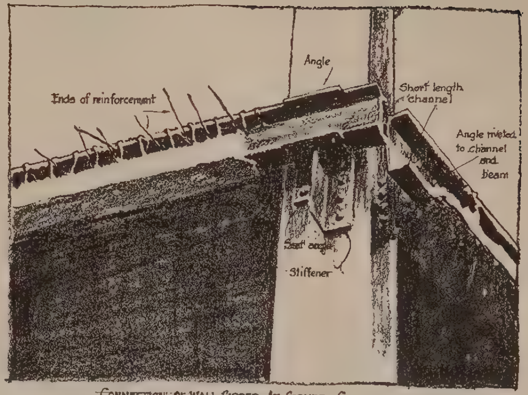
If We Could Only Keep These Two Typical Bays In A Steel Floor Frame Of Apt. House As Simple As This!

4.

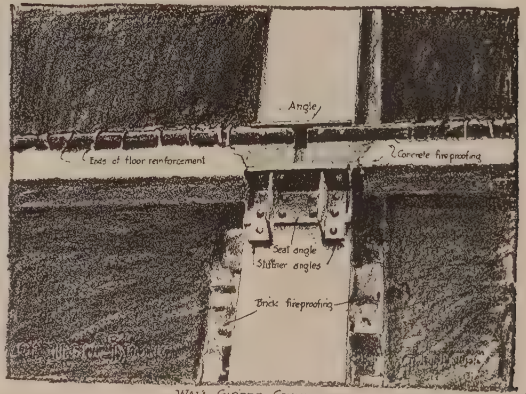


Interior View Of Corner Column

9.

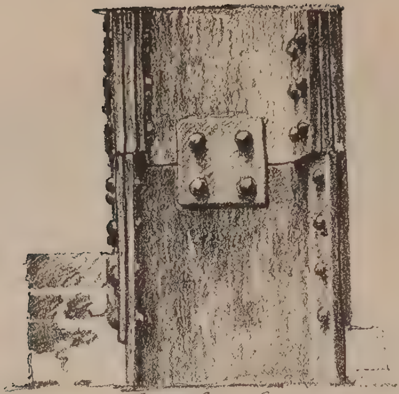


Connection Of Wall Girder At Corner Column

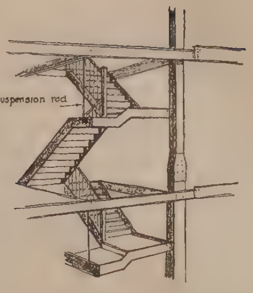


Wall Girder Connection

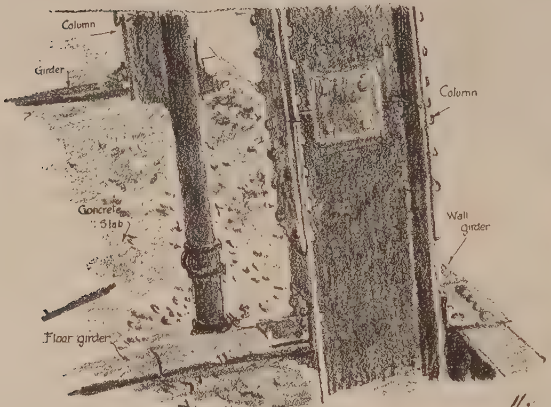
7.



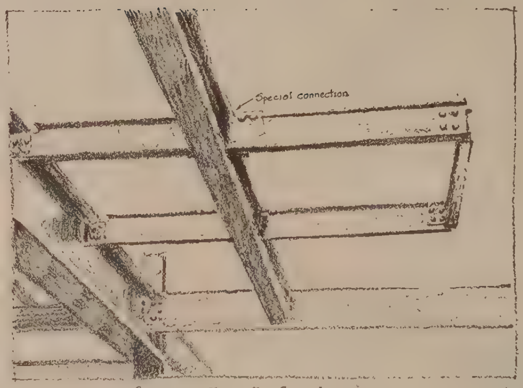
TYPICAL COLUMN SPLICE 12.



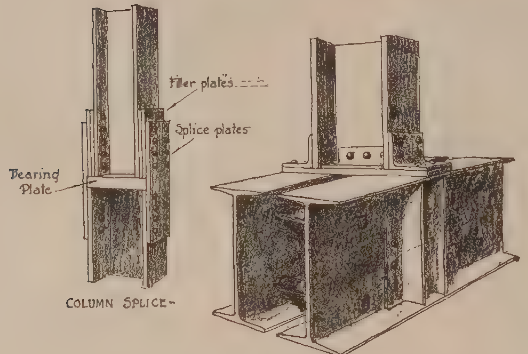
STAIR · CONSTRUCTION – 15.



SIDE VIEW 11.

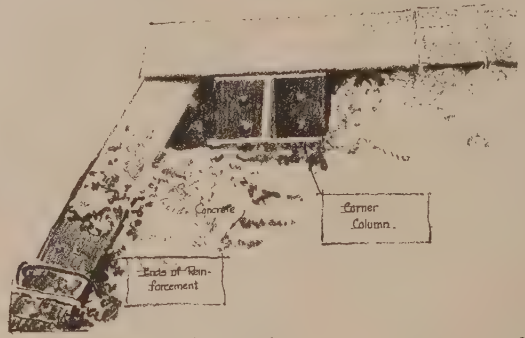


CANTELEVER FRAME FOR STAIR LANDING 14.



COLUMN SPLICE –

Simple Grillage Base 10.



· AT · THE · Roof · 13.

is made to limit the spans of girders to 22 feet or less, the average being between 14 feet and 18 feet. In some apartments 12-inch-deep girders are the largest used; but these are not standard sections, but rather Bethlehem sections. If standard sections were necessary, 15-inch I-girders would have to be employed.

As wire-mesh reinforcement is used for the concrete floor-slabs between beams, the level of the top of the concrete usually comes flush with the top of the steel beams. In a building under construction one can see the reinforcement stretching over the top of the beams. As the finished floor is only 4 inches above the top of the steel, not much space is left for plumbing-pipes, and therefore it becomes necessary to drop the level of the concrete floor-slab in bathrooms about 5 inches below the level of the rest of the floor. This makes the ceilings in bathrooms lower than in the other rooms; but it is a better arrangement than to raise the level of the bathroom floor above the other floor.

The columns in the exterior wall are usually spaced to coincide with the partitions of the important rooms. Even then they produce an awkward projection in the corner of the room. Girders extend from these columns at a right angle to the outside wall, and as far as is possible they are received by interior columns. But very often they are received by another girder running between two interior columns, forming a T-shaped frame.

The exterior columns are made of rolled Bethlehem H sections. They are spliced at every other story about 18 inches above the floor-beams. The upper lengths are 8-inch sections, and they are increased by intermediate sizes with the accumulation of weight they carry to 14-inch sections on the lower floor. In order to have the necessary amount of masonry on the exterior, they are set with their centres back from the face of the wall 1 foot 3 inches.

The splices used between sections of almost similar size are quite simple. Splice-plates are riveted to the flanges and a small splice-plate on each side of the web, as shown in the sketches. Where sections are radically different in size a bearing-plate must be set between their ends. Filler-plates are used between the splice-plates and the flanges to allow a snug connection with the smaller upper section.

The bases of columns are usually spread over the concrete footings with two rolled I-beam sections, fastened together with gas-pipe separators. If the load of the column is excessive, angle stiffeners are riveted to the webs under the column.

The connections of all girders, beams, or wall girders, or beams to girders within 3 feet of the columns, are made with field riveted joints. Other connections are bolted and not field riveted.

As wall columns are set so that their webs are at right angles to the wall, the connections for the wall girders are made on their flanges. These connections are usually made with short lengths of an angle riveted to the column horizontally above and below the flanges of the wall girder, the outstanding legs of these angles being riveted to the flanges of the girder. The lower angle, or shelf angle, is stiffened by one or two bracket angles, set vertically, with outstanding leg bracing the outstanding leg of the shelf angle. Another type of connection uses four angles, so riveted that they form an H. One pair of legs is riveted to the column, the other to the web of the wall girder.

The connections at the corner are more complex. The girder fastened to the flange of the column is connected by the usual arrangement of seat connections just described. The wall girder that must run parallel with the web of the column requires a special connection. A short length of channel is riveted to the rear flange of the column, and extends, cantilever fashion, out to the web of the wall girder. An angle is riveted to the end of this channel, and also to the web of the girder, making the connection complete.

Connections of interior girders to columns are usually seat connections, but often girders are very eccentrically placed on the side of the column. These require special bracket plates, and in fact special connections for each case.

Standard web connections are made between floor-beams and girders. The web angles are sent to the building riveted to the webs of the floor-beams. The outstanding legs of these angles are bolted to the girders unless they come within 3 feet of a column, when they are riveted.

The framing around stair-wells is often complicated with cantilever beams. If the standard web connections are not strong enough, flange plates or special angles must be used. The illustration shows such a problem.

Stairs themselves are supported by $\frac{3}{4}$-inch tie-rods, which suspend the platforms from the beams that frame around the openings, as shown in the drawing.

Tanks are either supported on three or four columns, extended above the roof, and which uphold girders on which the tank rests. This framework is braced diagonally in all directions with angles.

(*To be continued*)

A Unique Hotel and Office-Building

Wesley Building before alteration and addition.

THE new fourteen-story hotel and office-building now completed at the northwest corner of 17th and Arch Streets, Philadelphia, is a unique example of architectural and engineering knowledge employed in the attainment of the satisfactory development of central real estate and proper financial returns upon the invested capital.

Originally erected in 1914 for the Board of Home Missions and Church Extension of the Methodist Episcopal Church as a six-story and basement office-building, with provision for six additional stories, the building is now fourteen stories high. It is occupied in the first story and seventh to fourteenth stories, inclusive, by the new and modern Hotel Robert Morris, and in the second to sixth stories, inclusive, by the Wesley Office Building. Located within one hundred feet of the Parkway, and only two blocks from the Pennsylvania Railroad Station, as well as being convenient to the Reading Railroad Station, it occupies a prominent and readily accessible position in the central part of the city.

Prices were obtained in 1920 for the erection of six additional stories to the building, making twelve in all, for office purposes. Owing to the high prices prevailing in 1920, it was found that the prospective revenue obtainable from six additional stories of offices did not meet the requirements of a satisfactory investment.

In the meantime, however, the existing city requirements of 100 pounds per square foot of floor had been reduced to 60 pounds for office-buildings and to 40 pounds per square foot for hotel buildings. After making the necessary calculations and investigations, the architects and engineers ascertained that by utilization of the reserve strength in the existing structure, and by careful design of the new superstructure, eight additional stories for hotel purposes could be erected instead of proposed six stories for offices. They accordingly suggested the erection of eight stories for hotel purposes, and named a possible tenant. Satisfactory prices on the hotel basis and the tenant named having been obtained, erection of the new work was begun in 1922.

The original Gothic design, adopted in recognition of the character of the ownership of the building, has been followed throughout. The exterior of the building is faced on all sides with light-colored matt-glazed terra-cotta. The construction is of steel frame, with concrete fireproofing, concrete floors and fireproof partitions; the corridors having terrazzo floors and washboards, with marble washboards in the rooms. The north and west windows, overlooking other properties, are all polished plate wire glass, in metal frames, for fire-resisting purposes. In addition to the main stairway, a special fire-and-smoke-proof tower stairway has been provided for the safety of guests.

The lobby, lounge, office, and service rooms, together with the restaurant and kitchen, are located in the first story, with public toilets and barber shop in basement. Each of the eight upper stories contains 28 bedrooms, each with its separate bath, making a total of 208 bedrooms in all, of which 72 are single rooms and 136 double rooms.

Every modern convenience has been provided, including three high-speed electric passenger-elevators, electric lighting, vacuum-cleaning system, with hot and cold water, and filtered, sterilized, and refrigerated drinking-water in each room. The plumbing, heating, and ventilating are of the most sanitary and efficient type. An electric fire-pump of 500 gallons' capacity per minute, connected to the city water-mains and supplying water to a stand-pipe with hose at each story and on the roof, provides added fire protection.

The Ballinger Company, architects and engineers, Philadelphia and New York, whose organization was in charge of the original building, were commissioned by the Board of Home Missions to design the new combined hotel and office-building, and its entire equipment, together with the supervision of its erection.

An ordinance of City Councils gives to Philadelphia's Art Jury authority to pass judgment upon the architectural design of all new buildings erected within a distance of one hundred feet of the Parkway, the main boulevard from City Hall to Fairmount Park.

While the Wesley Building is located at the corner of 17th and Arch Streets, with its main façades upon these two thoroughfares, a portion of it lies within the one hundred foot jurisdictional limit, thereby presenting the two party walls to view from the Parkway.

Consequently it was not possible to follow the unfortunate but customary practice of disregarding the architectural treatment of the party walls but it was necessary to give them special study in order to create a harmonious effect by carrying out the design of the original six story building, which was in the Gothic style. The accompanying plates illustrate the exceptionally successful results obtained by undercutting and recessing the terra cotta on the party walls to produce the lights, shades, and lines of the Gothic where it was not permissible to project beyond the party lines.

The effect created has been no less interesting than the main façades and up to this time represents the most satisfactory party wall treatment of any of Philadelphia's tall buildings.

Shows Overburned Lime is Cause of "Popping" in Plaster

LIME which has been overburned, or which has been burned during hydration, is the cause of popping in plaster, tests made at the Bureau of Standards have shown. In this type of failure small particles appear to expand and push themselves out of the plaster, leaving tiny holes. In extreme cases these holes may be sufficiently large or numerous to be unsightly. It has been shown that popping will not be serious if the lime is ground fine enough to pass a No. 50 sieve, as in that case the lime will be completely hydrated during the mixing and application, or else the particles of defective lime will be too small to cause noticeable holes.

These tests were made in co-operation with the National Lime Association, the Contracting Plasterers Association, and the International Plasterers Union. Ninety-eight panels were erected containing different impurities in different sized particles. It was found that, with the possible exception of sand, impurities other than overburned lime did not cause popping, no matter how coarse they were.

The Index for Volumes XLVII and XLVIII

THE index for the numbers included in the year 1923 is now being prepared, and will be sent free to all who request it.

This will be found a very handy reference in looking for the things ARCHITECTURE has published, and we believe it will be a convincing proof of the fact that this magazine furnishes a valuable showing of much of the important architecture of the past year.

The United States Veterans Bureau has recently organized a Construction Division in the Arlington Building, Washington, D. C., and would appreciate recent data and catalogues from manufacturers of building materials and specialties, which would enter into hospital construction and utilities.

The Lighting of Museums

By M. Luckiesh

Director, Laboratory of Applied Science, National Lamp Works, Nela Park, Cleveland

OBJECTS in museums owe their distinction to their appearance because it is through the visual sense that they are appreciated. This means that light is essential, but it also means more because the appearance of an object depends largely upon its lighting. This statement is made with cognizance of the fact that art "appreciation" in some cases springs largely from cost, possession, rarity, and antiquity, but this is not true appreciation. In order to justify museums, the value of the objects must be based largely upon their appearance. Any museum which houses collections of artistic or of historic interest having little value excepting that arising from visual sense, is a monument of hypocrisy in proportion to the neglect of the lighting of the objects within it. And likewise art appreciation becomes a sham, if the objects are ill lighted, and even worse if based merely on cost, possession, rarity, antiquity, etc. Still, many museums are not well lighted. In fact, few museums expend time, money, and ingenuity in lighting at all commensurate with its importance, considering the value of the objects which they house and the value of the building itself.

Too often it is not realized that paintings, sculpture, jewels, furniture, architectural details, interiors, etc., are largely expressions of light.* The painter fixes an expression of light, but it is not really fixed, for the quality and distribution of light—the lighting—modifies its expression considerably. The sculptor in chiselling his work really leads lines of light and shade here and there. He fixes an expression of light for the particular lighting conditions under which he works. So it is with architectural details. The decorator produces a certain expression in a room by distributing values and hues over large areas and details of design and of furnishing here and there.[*] This expression is fixed only for a particular lighting condition.

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* "Artificial Light," chapters XXIII and XXV, by M. Luckiesh. Century Co., 1920.

By altering the distribution and quality of light any expression of light can be altered. The importance and possibilities of lighting must be appreciated if we are to utilize the potentiality of light. The museum is full of objects whose expressions or appearances are very susceptible to the lighting. Furthermore, the lighting equipment and the daylight openings should be so designed and placed as to make for the best conditions of seeing.

General Considerations

Let us first consider some of the general characteristics of natural and artificial light and lighting. The quality or color-value of daylight is that to which the visual process has become best adapted throughout eons of evolution. In the museum the sky is the important source of daylight unless diffusing glass is used in windows and skylights to diffuse the direct sunlight. The greatest disadvantages of natural daylight are its undependability and the difficulty of controlling it indoors. Modern artificial light-sources are such that the light can be controlled as desired and any of countless lighting effects can be produced. Artificial daylight[†] is now available so that art objects can be shown in their true colors or, in other words, as they were produced by the artist or craftsman under natural daylight. It is well known that many colors fade[‡] under natural daylight that are quite permanent under proper artificial light. Thus in every way natural lighting is inferior to artificial lighting.

We are slaves to natural light in our museums chiefly due to habit acquired in the countless centuries of inadequate artificial light, and to the accepted but erroneous idea that natural light costs nothing or at least not much. As a matter of fact, natural daylight indoors costs as much and usually more than artificial lighting when such factors as investment in equipment, heat-losses, maintenance, and depreciation are considered.[§] In art museums natural daylight, undependable and difficult to control, costs considerably more than adequate, constant, and controllable artificial light does without considering such factors as fading and also the destruction due to dirt entering through daylighting equipment. The foregoing is presented for the purpose of having the facts before the reader. There are many places where we will never give up natural daylight, but there are many places where economic considerations and satisfactoriness are going to combine in favor of artificial lighting and of the exclusion of natural lighting. Some of the galleries in museums are going to be built without natural daylight because from all important angles this is the wise thing to do. The problems of lighting in museums are manifold and they can be best considered by treating the various types of exhibits separately. It is common in designing the lighting of a museum to find that no definite decisions have been made as to the type of exhibit that is to occupy most of the rooms. What is proper lighting for a paintings gallery is not the best for sculpture, for example, as should be obvious from a consideration of the requirements of the two cases. For the present purpose the exhibits will be divided into paintings, sculpture, cases, and miscellaneous. The lighting problems are particularly different for the first three types, and combinations of the various requirements are found in the miscellaneous exhibits, involving archæology, natural history, furnished rooms, etc.

A well-lighted museum is best assured and accomplished by close co-operation between the architect and the lighting specialist so that details of construction help instead of hamper the lighting specialist. Furthermore, by fully realizing the importance of lighting and its influence on the expressiveness as well as the visibility of objects, the architect will find that in the design of a museum there are large and small structural details which can do much to make an ideal housing for objects owing their appeal and consequently their position to their appearance. The ideal museum structure has not as yet been built. It will be built by an architect who fully appreciates the true primary aim of a museum and who will design the building around the lighting requirements of specific exhibits.

Paintings Galleries

In a gallery of paintings the important area is the lower portion of the wall from 2 to 10 feet above the floor. The chief problem is to illuminate this portion of the wall to an intensity of a few foot-candles without unduly illuminating other areas. The chief lighting fault with galleries illuminated by means of overhead horizontal skylights is the relatively greater component of light vertically downward than diagonally downward toward the lower wall. This leaves the paintings much less intensely illuminated than the floor, which is an unsatisfactory condition for view-

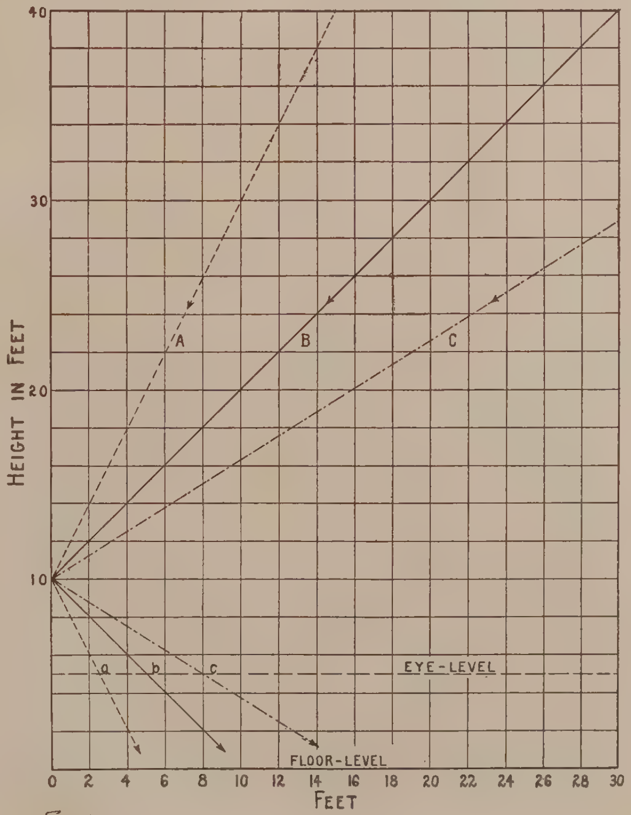

Fig. 1—

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[*] "Lighting the Home," by M. Luckiesh. Century Co., 1920.

[†] "Color and Its Applications," chapter XI, by M. Luckiesh. D. Van Nostrand Co., 1915.

[‡] "Windowless Museums," by F. A. Lucas, Natural History, 22, (November–December), 1922, p. 530.

[§] "Cost of Daylight," by M. Luckiesh and L. L. Holladay. Trans. I. E. S., 1923. Architecture, January, 1923.

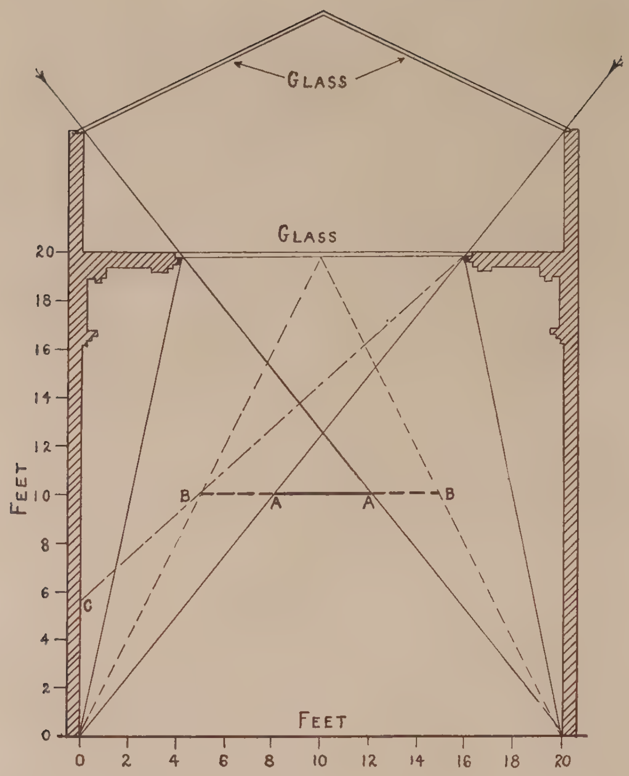

Fig. 2.

ing them. Such a strong vertically downward component is tiring to the unshaded eyes. But this condition is a natural consequence of a large expanse of overhead skylight of diffusing glass or of uncontrolled diffused light from the sky. Such a skylight or the sky emits light in any direction in proportion to the projected area, and therefore the greatest intensity of light is downward. Furthermore, the intensity of illumination, or the quantity of light per unit of area on the paintings, is further reduced because they are not perpendicular to the dominant direction of the light from the skylight.

The side-lighted gallery of paintings is wasteful of hanging area, and is generally unsatisfactory for important galleries. The paintings opposite windows generally reflect the image of the window or the sky, which causes very unsatisfactory visibility. The side-walls are more satisfactory but the intensity of illumination varies considerably from a point near the windows to a point far from it. Side-lighted galleries are best used for small groupings of furniture, tapestries, a few paintings and other objects.

The top-lighted gallery offers the best solution for paintings galleries if certain precautions are taken. The chief aims should be as follows:

1. To provide artificial light approximating the quality of natural daylight.

2. To avoid reflection of images of the skylight, sky, or artificial light-sources, into the eyes of the observer of the paintings.

3. To provide an intensity of illumination on the paintings equal to or, preferably, greater than that on the floor.

The first aim is accomplished by using modern tungsten lamps, whose light approximates the quality or color-value of natural daylight. These are desirable not only when natural light fails but also during the many hours in the daytime when natural light is inadequate.

The other two aims can be realized by studying the particular conditions and applying simple optical laws. In Fig. 1 the matter of reflected image of skylight or other light-source is treated on the basis of the simple law which states that the angle of reflection is equal to the angle of incidence. The eye-level is approximately 5 feet above the floor. If we concern ourselves with a hanging space of a maximum height of 10 feet above the floor, this highest point is the one of greatest interest from the standpoint of images of light-sources reflected from the varnish or glass covering of paintings. If it is desired that the observer shall not see any images of light-sources at the eye-level further away than *b* (5 feet from the wall), no light-sources, sky, or bright skylight can be within the angle made by *B* and the wall. For example, in order that this may be fulfilled no sky area, no artificial light-source, nor no other very bright area can be further than 10 feet from the wall if it is 20 feet above the floor. This distance grows less as the height is reduced, and greater as the height is increased, as seen by following the line of incident light indicated by *B*. The ray or plane of rays indicated by *A* are reflected downward still more than *B*, striking the eye-level at *a* instead of at *b*. If the ceiling is 24 feet above the floor a diffuse skylight or sky area can extend as far as 14 feet from the wall without the observer seeing the image reflected from the point 10 feet above the floor when he is 5 feet from the wall.

This specification is difficult to fulfil excepting by means of artificial-lighting equipment which directs the light very well. Inasmuch as relatively few paintings extend as high as 10 feet above the floor, the specification may be made less difficult to fulfil by aiming to have the images of the light-sources, reflected by an area 10 feet above the floor, confined to the portion of the eye-level between *c* and the wall. That is, the observer will not see the images reflected

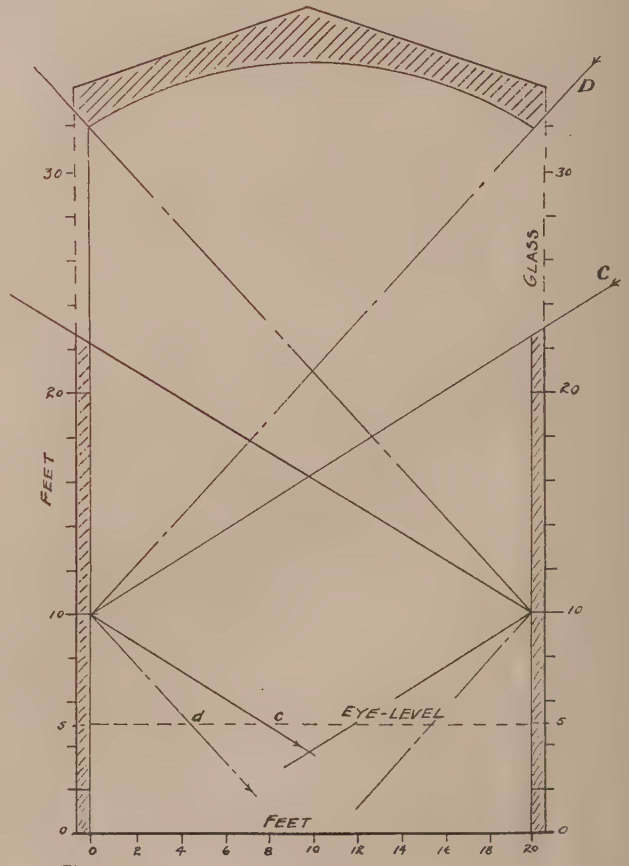

Fig. 3.

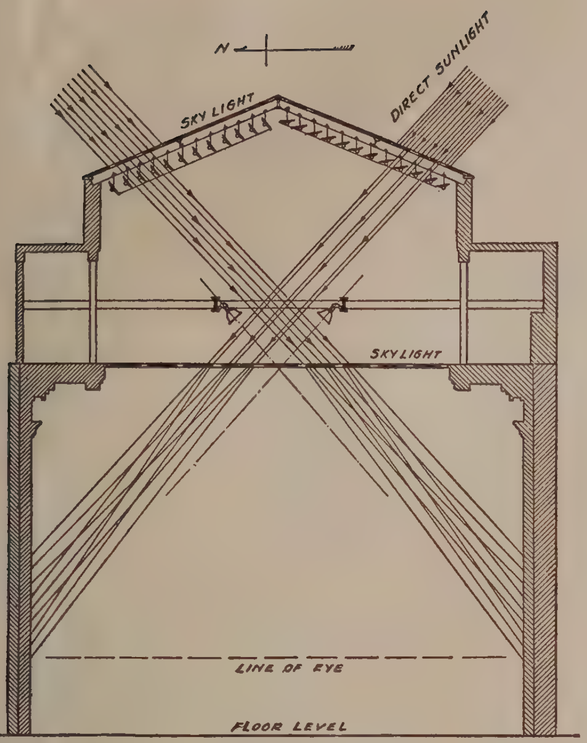

Fig. 4.

from the 10-foot level until he is 8 feet from the painting or closer. In this case the light-sources, sky areas, etc., must be confined only within the angle between *C* and the wall. Now if the height of the room is 20 feet, the skylight through which the sky is visible can extend 16 feet from the wall. Such a diagram will reveal the limit of location of light-sources or of the extent of skylight or sky areas.

Thus disposing of the matter of location of the primary light-sources and thereby fulfilling the second aim, let us consider the third aim. In the case of natural light from the sky it is practically impossible to control the light very much by changing its direction; however, it is possible to some degree to intercept it in certain directions and permit it to go uninterrupted in the directions desired. Of course, prism glass and mirrors may be used, but the cost and maintenance of adequate systems of these, added to the other costs of daylight, would only emphasize the desirability of providing only artificial light.

The velum supported horizontally below the skylight is a makeshift which reduces the intensity upon the floor. It also reduces the intensity on the paintings, but not to such an extent.

In Fig. 2 we have a subskylight area of the largest extent desirable as determined by its height, and a roof-skylight of proper area in relation to it. If a velum is to be supported 10 feet above the floor, its width cannot be greater than *AA* if there is to be no reduction of light on the lower walls. However, it is obvious that this small area would not reduce the intensity on the floor very much. If it were retained at 10 feet above the floor and extended to *BB*, it would obscure about one-half the skylight area from points along the bottom of the walls, and the wall 6 feet above the floor would be the area from which the entire skylight would be visible. This limit is shown by *BC*. For the same conditions to obtain with the velum supported higher above the floor, it must be proportionately smaller in width. Inasmuch as the velum is a makeshift at best, it will be passed by with this brief analysis. There are some galleries where such an expedient should be resorted to because the conditions would justify such an atrocious means, but there is no excuse in designing new buildings to produce a condition where the velum must be resorted to.

It is difficult to fulfil the second and third aims by using natural daylight, but it can be done to some degree. High clerestory windows, such as shown in Fig. 3, are one means of meeting the requirements, but the height of the gallery must be considerably greater than its width if the conditions of *C*, Fig. 1, are to be fulfilled. For example, if the room is 20 feet in width and reflected images from a 10-foot level are to be confined to within 8 feet of the wall on the eye-level, the lowest portion of the clerestory window cannot be lower than about 23 feet above the floor. In order to obtain adequate intensity on the lower walls, such windows must be rather tall. In this case the limiting rays *C* and *D*, reflected from the upper limit of hanging area (10 feet above the floor), cross the eye-level at *c* and *d* respectively. This fulfils the second aim and it is obvious that the fulfilment of the third aim is approached to some extent. Just how well the third aim is fulfilled can be determined by studying the projected areas of the windows at points along the eye-level and the hanging area. At best, the heights of galleries in which clerestory windows are used must be much greater than the width if satisfactory lighting conditions are to be obtained. Fig. 3 can be modified readily to meet any other dimensions of a particular case.

If an overhead skylight is used to admit light from the sky, its extent should be limited in accordance with Fig. 1 and some means, such as louvers, should be employed to intercept some of the light, which would otherwise reach the floor, without appreciably intercepting the light which is travelling diagonally toward the hanging space along the lower walls. Diagrams similar to the foregoing should be drawn to scale to ascertain the proper dimensions, such as height and extent, of the subskylight relative to the width of the room and the proper dimensions of the roof-skylight relative to the subskylight. The wall-areas at the end of the gallery are treated in the same manner, but the problem of natural lighting is generally less complicated if the galleries are long relative to their width than if they are more nearly square. In the case of artificial lighting, the relation of width to length of the room is of relatively less importance, for it is as easy to direct artificial light on an end-wall as on a side-wall. In the case of natural lighting, the rake of the sun and the necessity for another set of

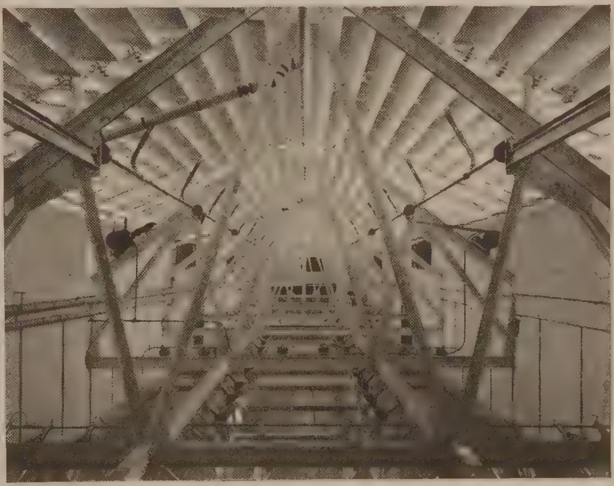

Fig. 5.

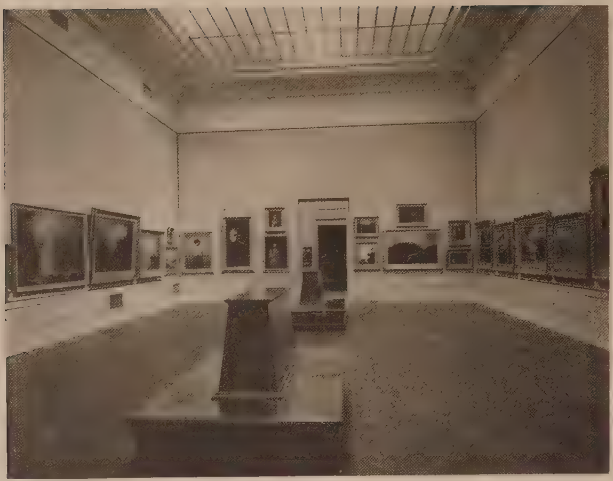

Fig. 6.

louvers to care for the end-walls present real difficulties which should be avoided if possible.

In Fig. 4 is shown a cross-section of the top-lighted galleries in the Cleveland Museum of Art.* The subskylight is not of diffusing glass but consists of "pebbled" wire-glass. The coarse pebbling scatters the light somewhat, and also serves to obscure the beams and other features above the skylight. Adjustable metal louvers 16 inches wide and 12 inches apart are located just under the roof skylight. These are electrically controlled in sections and it is possible to adjust those on one side independently of the other so as to balance the illumination on the opposite walls. The diagram indicates how the vertically downward component of light is reduced much more than the diagonally downward component.

These louvers and the artificial lighting were designed by Mr. E. J. Edwards, Mr. Ward Harrison, and the writer after the building was constructed. Certain difficulties would have been eliminated if the lighting had been considered in detail by the architects when they designed the chief structural details. Inasmuch as the Cleveland Museum was the first in the world to be lighted by "artificial daylight," and owing to the great amount of study given to the lighting, the reader may be interested in the detailed account.†

In Fig. 4 the artificial lighting equipment is shown supported on beams above the subskylight. This consists of modern silvered-glass projectors containing tungsten "daylight" lamps. Their number and spacing are such as to provide one unit for 3 feet to 4 feet of wall-length, and they are provided with the necessary adjustments for focussing the lamps and for directing the light into the corners and wherever desired. The louvers and artificial lighting projectors are illustrated in Fig. 5, the original photograph having been taken at a point about 6 feet above the subskylight. The artificial lighting effect is illustrated in Fig. 6.

The foregoing paragraphs cover the major phases of natural lighting. The artificial lighting of paintings galleries can be done more successfully and in a greater variety of ways. The projector system may be installed above subskylights, behind ceiling beams, in specially built housings on the ceiling, in artificial clerestory windows, in hanging lanterns, and in other obvious places. In general, the artificial light should be projected by proper silvered reflectors or refracted by prismatic-glass devices. The continuous trough directs very little of the light; it is more of a shade than a "director" of light. Adequate control of light can best be obtained by enveloping each light-source by a reflector or other directive device. Advantage of the distribution characteristics of lighting devices should be taken by the designer of museums. Inasmuch as artificial light can be controlled and directed at will, there are many ways of lighting museums satisfactorily if the three major aims are fulfilled.

If lighting units are to be hung from the ceiling, they can be so designed as to give an asymmetrical distribution of light, most of the light being directed toward the lower walls. Such units should be hung within the angle made by the line *C* and the wall in Fig. 1 if *C* is taken as the limit as explained in a foregoing paragraph. Such units may be housed in decorative lanterns with panels of denser glass on the sides not facing the walls. The decorative features need not be unduly interfered with by the scientific design. Another type of unit is that which provides, in general, a "bat-wing" distribution of light as in Fig. 7. Such units throw light predominantly toward the walls and are quite satisfactory suspended from the ceiling or installed above a subskylight in which the glass is merely of the "obscuring" type (pebbled, ribbed, frosted, etc.), rather than of the diffusing or milk-glass type.

The many types of glasses and of reflecting, refracting, and diffusing lighting devices make ~~it~~ possible to solve any artificial lighting problem ~~and to~~ improve natural lighting. These are so numerous and varied that they cannot be discussed in detail in this article.

Before leaving the paintings gallery, let us consider one example of construction which would result from a close co-operation of the architect and the lighting specialist. In a show-window, properly designed, the lighting units are completely concealed not far above and in front of the display, and the latter is seen distinctly and satisfactorily. Let us imagine a large gallery without any natural lighting. Along the lower walls is a continuous recess 7 or 8 feet deep and about 12 feet high. Efficient reflectors could be concealed above as usual in the show-window. High up in the central portion of the gallery would be hung some chandeliers to provide a moderate intensity of light on the floor, but the paintings hung on the recessed wall would stand out brilliantly and beautifully. Such an isolation of the hanging space would also make it easier to use a dark background without encountering the same difficulties that such a background would entail on the ordinary wall-spaces. From a lighting standpoint such a scheme would be ideal. Certainly, there will arise some day an architect who can solve the æsthetic problems involved, and who will have the courage to do so.

(*To be continued*)

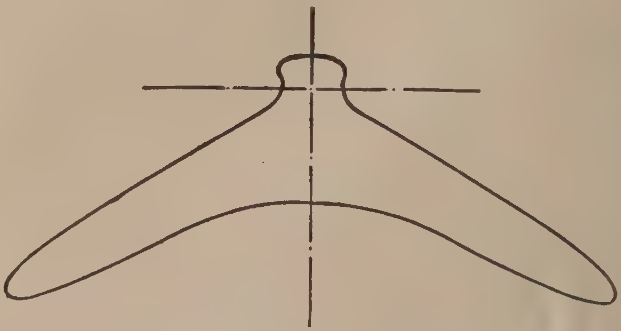

Fig. 7.

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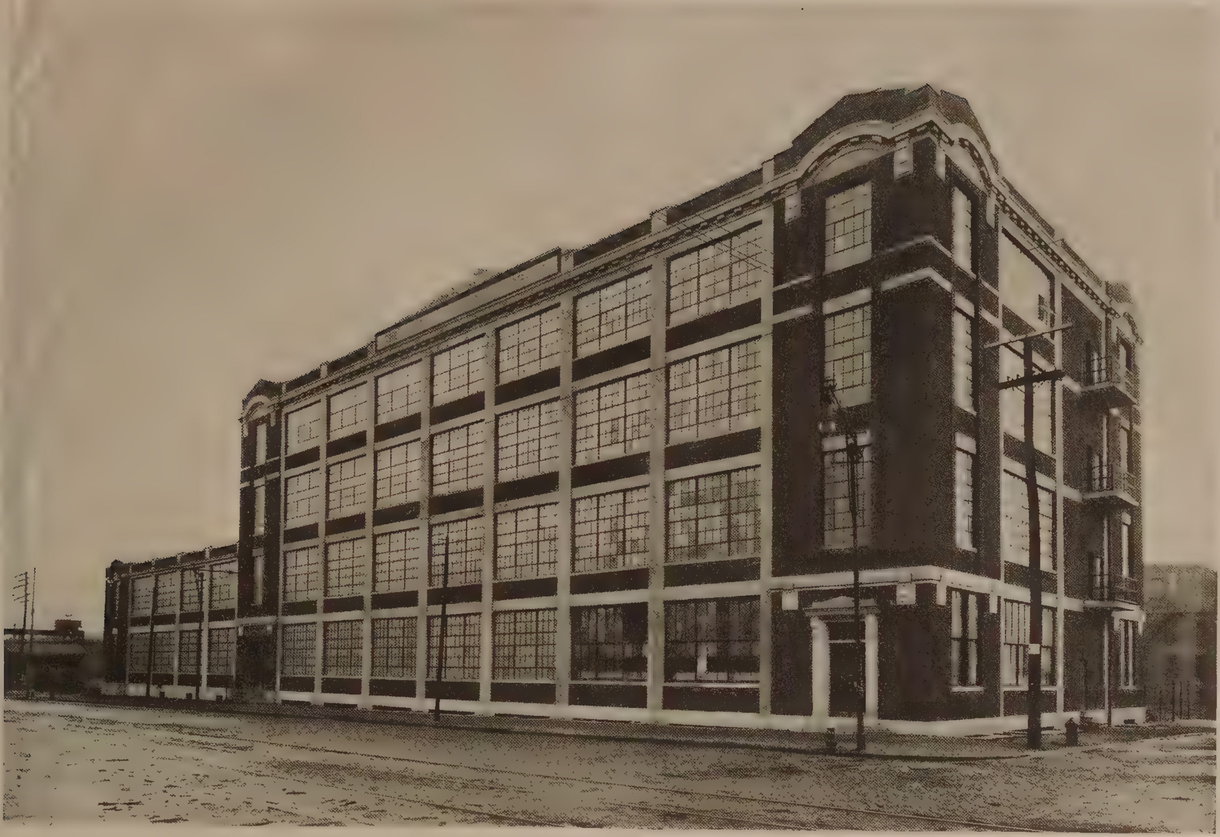
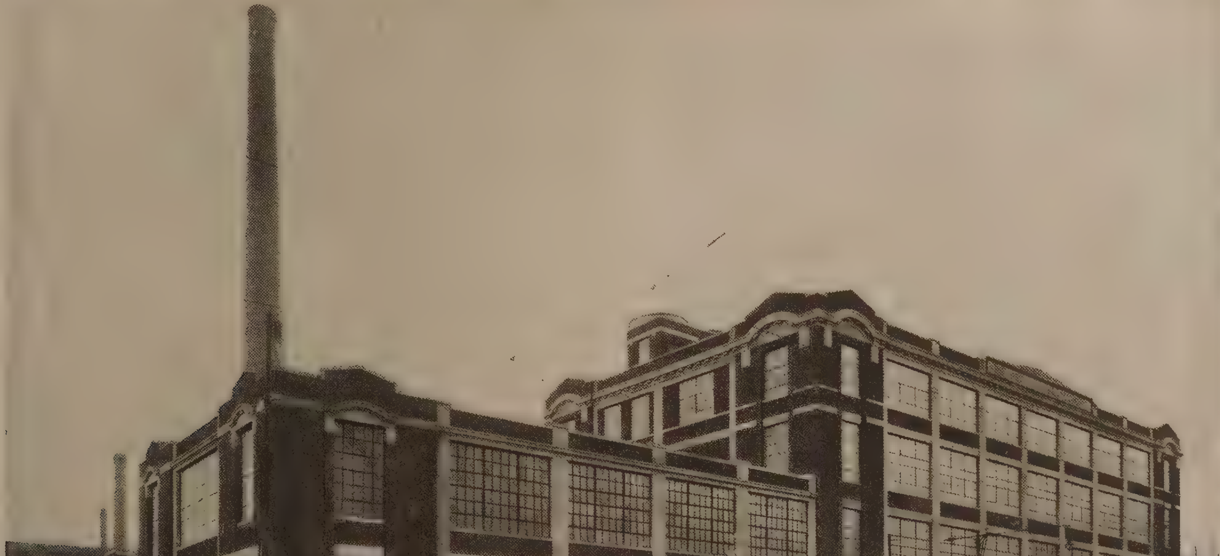
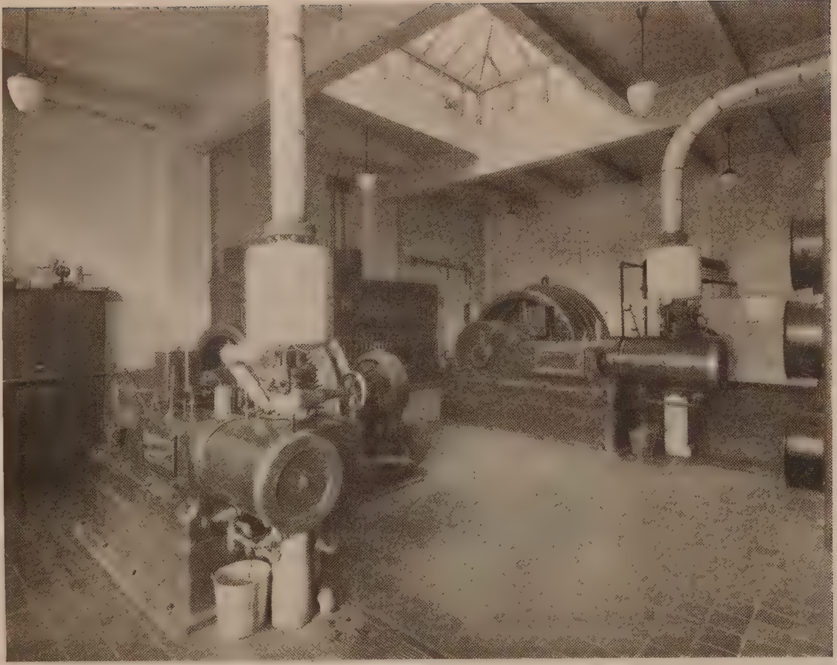
* "Lighting of the Cleveland Museum of Art." Trans. I. E. S., 1916, p. 1014.

† "Lighting of the Cleveland Museum of Art," 1916, p. 1014.

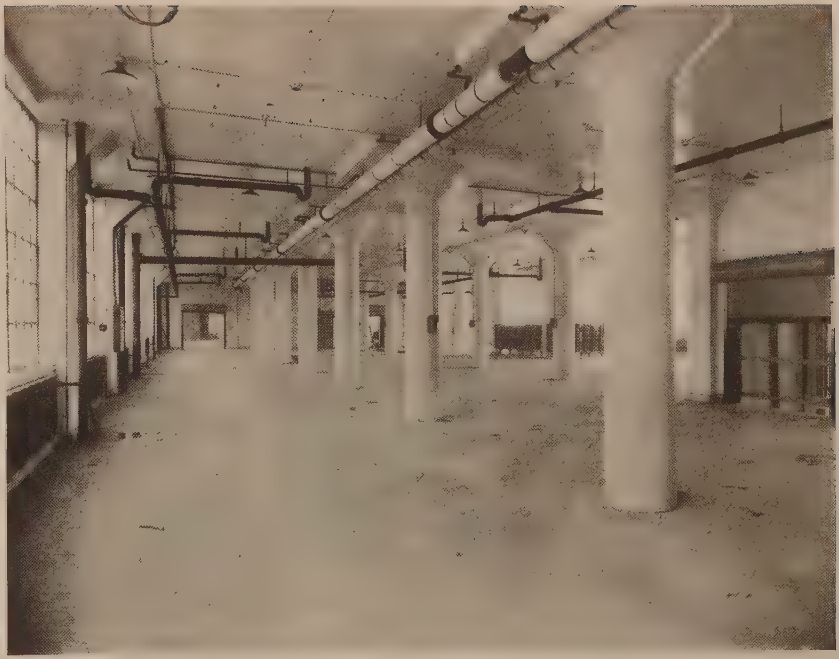




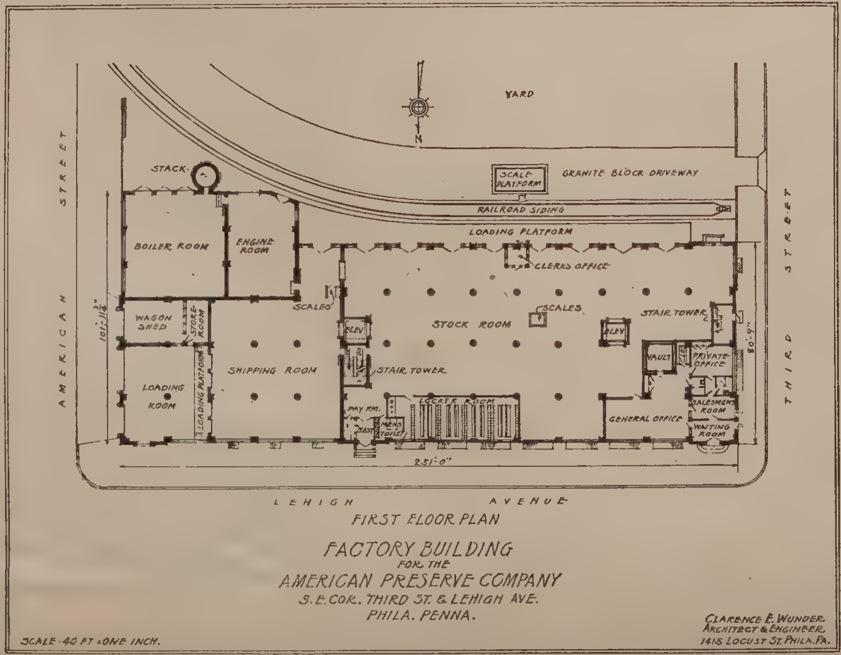
FACTORY BUILDING FOR THE AMERICAN PRESERVE CO., PHILADELPHIA, PA. Clarence E. Wunder, Architect.

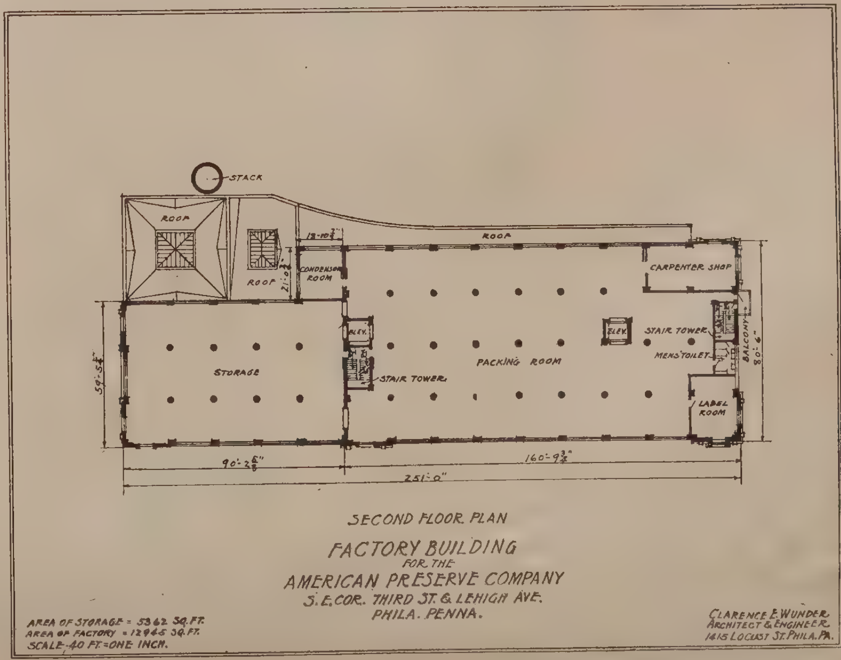


INTERIOR OF BOILER-ROOM.



INTERIOR.





FACTORY BUILDING FOR THE AMERICAN PRESERVE CO., PHILADELPHIA, PA.

Clarence E. Wunder, Architect.

Drafting-Room Mathematics

By DeWitt Clinton Pond, M.A.

FOURTEENTH ARTICLE

IN the last article the method of multiplying by means of the slide rule was discussed, and several examples were given in order to illustrate the method. There was also a discussion regarding the placing of the decimal point in the problems in which multiplication was involved. In the present article the process of dividing one number by another will be taken up and the location of the decimal point will also be considered, as the method of placing it is different when calculations requiring division are investigated.

It is a simple enough matter to state that the process of division is the reverse of that of multiplication, but there is something more to it than just this. The student must acquire the habit of sliding the runner to the proper position and then of operating the slide so that these actions become almost automatic, and these are somewhat different from those used when two or three numbers are multiplied.

It will be recalled that in the previous article the problem of multiplying 25 by 3 was undertaken and it was shown that it was necessary to first slide the runner to two-five, then to slide the left hand index—the left hand 1 on the C scale—under the hair line on the runner, and then to slide the runner so that the hair line is over 3 on the C scale and to read the answer seven-five on the D scale.

In the present case let it be assumed that it is necessary to divide 75 by 3. In such a problem it is necessary to first slide the runner so that the hair line is over seven-five on the D scale. Then, instead of placing either the left or right hand index under the hair line, it is required, in the case of division, that the divisor—in this case 3—be found on the C scale and placed under the hair line. Then the runner is located so that the line is over the index—either right hand or left hand—that is next to a number on the D scale, and the number under the line on this scale is read as the answer. In the present case the number is 25.

The reader should be sure that he has mastered the process of first sliding the runner so that the hair line is over the dividend, on the D scale, then of sliding the C scale so that the divisor is under the line, and of sliding the runner to the index, and of reading the answer on the D scale. The steps are illustrated in Fig. 53 and Fig. 54. In the first figure the runner is shown with the line over 75. In the second, at *a*, the 3 of the C scale is placed under the line, and at *b*, the runner is set over the left hand index. The answer is given on the D scale.

In the previous article there was also an example given in which 54 was multiplied by 26, and as an example in division it may be well to carry through the problem of dividing 1,404 by 26. In this case the runner should be set so that the line is over 1,404 on the D scale. It will be necessary to estimate the last digit of this figure, but this is not difficult to do, as the space between one-four and one-five is divided into ten fairly large divisions and it will not be arduous to estimate four-tenths of the first one. The next step is taken when 26 on the C scale is placed under the line as at *b* in Fig. 55. The next one is accomplished by simply sliding the runner to the right until the line is over the right hand index, and then it is only a question of reading the answer, in this case 54, on the D scale.

Because the problems which have been given in division are similar to those in multiplication as explained in the last article, there has been no difficulty in placing the decimal point. However, in problems which are the least bit complicated this question as to where the decimal point is to be placed is an important one. The method of determining its position is indicated if one observes the position of the slide in the examples given above. When 75 was divided by 3 the slide *projected to the right.* Bear this in mind for a moment.

The result of the division was 25. In the number 75 there are two digits, in the result—25—there are also two digits. It is therefore safe to say that in division, when the slide projects to the right, the number of digits in the result is determined by subtracting the number of digits in the divisor from the number in the dividend and *by adding one* to the result.

Try this in a simple problem. Divide 9 by 3. Slide the runner so that the line is over 9 on the D scale. Place 3 of the C scale under the line, and slide the runner back to the left hand index on the C scale; the answer is, of course, 3, as shown on the D scale. There is one digit in the dividend, one in the divisor, and one in the result. So the rule given above seems to apply in this example also. It will be found to hold true in even the most complicated problems.

In the second example given above, in which 1,404 was divided by 26, the slide projected to the left. Here there was a condition in which there were four digits in the dividend, two in the divisor, and two in the result. It is safe to say that in the case where the slide projects to the left it is necessary to subtract the number of digits in the divisor from the number in the dividend and the result will give the number of digits in the result.

Try this in a simple example such as dividing 12 by 4. Slide the runner so that the line is over one-two, bring the four of the C scale under the hair line, and slide the runner to the right hand index and read the answer—3—under

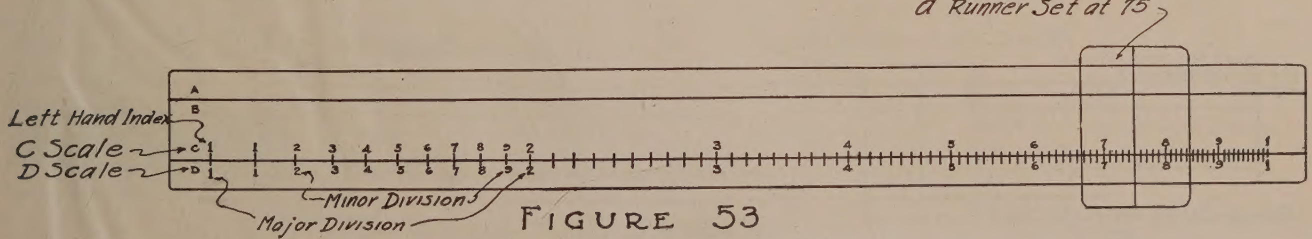


FIGURE 53

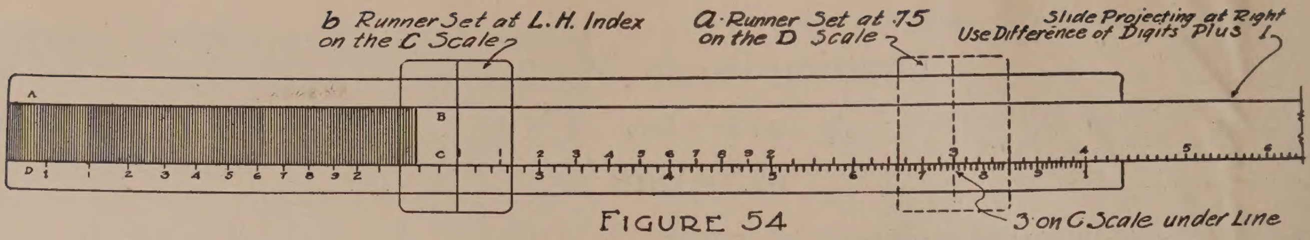

b Runner Set at L.H. Index on the C Scale
a Runner Set at 75 on the D Scale
Slide Projecting at Right Use Difference of Digits Plus 1.
A
B
C
D
3 on C Scale under Line

FIGURE 54

the hair line on the D scale. Here is a problem in which there are two digits in the dividend, one in the divisor, and one in the result. By subtracting the number in the second from the number in the first a difference is obtained that gives the proper number of digits in the answer.

There are those who think that these rules are hard to remember and complicated when put into practice. It has been the author's experience that this is not the case and that it simply requires a certain amount of practice to determine the position of the decimal point in even problems of considerable length. Note, however, that practice is absolutely required, and that one should not be discouraged by a few failures at the start.

So far the problems have been simple enough. They could have been carried out by the ordinary processes of arithmetic in about the same time that it takes one to carry them through on the slide rule. The advantage of using the rule is more apparent when there are more numbers involved in the calculations.

Suppose that one wanted to determine how many building lots measuring 75 by 125 feet are contained in an acre. This is a simple example but it can be answered quickly by means of the slide rule. By referring to any handbook it will be found that an acre contains 43,560 square feet, and the problem can be stated as follows:

$$\frac{43{,}560}{75 \times 125} = x$$

In order to carry out the problem on the slide rule it will be necessary to place the runner so that the line is very slightly to the right of the four-three-five line, and then to bring seven-five on the C scale under the line. The next step is to slide the runner to the right until it coincides with the right hand index, noting that the slide projects to the left. Then run the *slide* to the right until one-two-five is under the line. The runner must be moved again, this time to the left, while the slide projects to the right. The answer can be read on the D scale as four-six-four-five, the last two figures being estimated, as the line is only a very small space to the left of four-six-five.

Now to place the decimal point. In working out the method as given above, it was noted that the slide projected once to the left and once to the right, therefore it is necessary to subtract the number of all the digits below the line from the number above the line and add one to the difference. There are five digits above and five below the line and the difference is zero. By adding one to this the number of digits in the answer is found to be one, and the result can be written 4.645, which is the number of plots in an acre.

It will be noted that there is nothing complicated about determining the position of the decimal point. In the example it was necessary simply to remember the number of times that the slide projected to the right and to add this number to the difference.

So far such problems as have been given have dealt with multiplication or division separately, but it is possible to use the slide rule in problems involving both. Let it be assumed that the reader has to solve a problem in proportion. In a set-back problem it is desired to carry a bulkhead measuring 40 feet along the street wall above the height limit, and say the street frontage of the building is 140 feet. Sixty per cent of this frontage is 84 feet, which is the base of the triangle. The altitude of the triangle is 60 feet, as shown in Fig. 56. The proportion is developed as follows:

$$60 : x = 84 : 40$$
$$60 \times 40 = 84x$$
$$\frac{60 \times 40}{84} = x$$

In order to determine the value of x by means of the slide rule it is simply necessary to slide the runner so that the line is over 6, then put 84 in the C scale under the line, and the last operation is to slide the runner so that the line is over 4 on the C scale. The answer is 28.6, as read on the D scale. It will be noticed that instead of multiplying the two numbers in the numerator and then dividing, the process given above called for dividing 60 by 84 and then multiplying by 40. This saved one setting of the rule. As far as the position of the decimal point is concerned, this can be determined by noting that the slide is at the left all the time. In the case of division it is simply necessary to subtract two digits from two, leaving zero. Then, when this result is multiplied by 40, there are two digits added, so that there are two digits in the answer, at the left of the decimal point.

A particularly useful type of the slide rule problem is that in which it is required to determine the sidewalk elevations at various points along a street front when there is a pitch to the grade. Suppose that in a length of 149 feet 8 inches there is a difference of level of 3 feet 8 inches, and it is required that the elevations be determined at

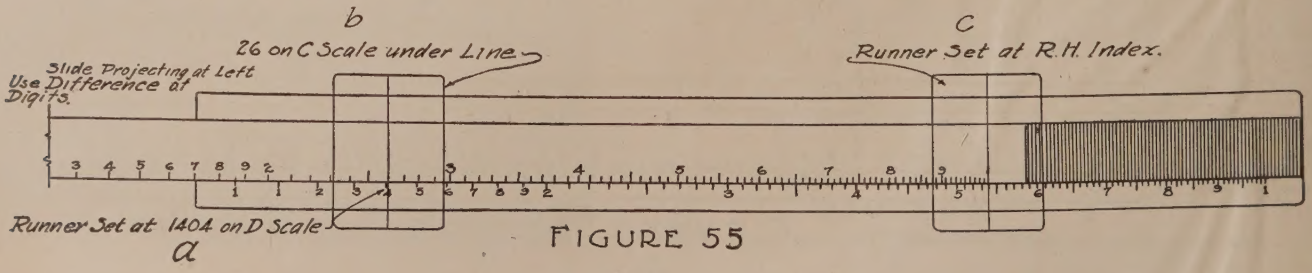

b
26 on C Scale under Line
Slide Projecting at Left Use Difference of Digits.
c
Runner Set at R.H. Index.
Runner Set at 1404 on D Scale
a

FIGURE 55

points 40 feet, 52 feet 6 inches, and 104 feet 2 inches from the low point.

The total difference in grade between the low and the high points is 44 inches. The problem can be resolved into dividing 44 inches by 149.66 and then multiplying by 40, 52.5, and 104.17.

To do this by means of the slide rule it is simply necessary to slide the runner to four-four and to place one-four-nine-six-six under the hair line. The last two digits must be estimated. It will be found that if it is desired to multiply by 40 and 52.5 it will be necessary to set the slide, but this is not the case when multiplying by 104.17. When this is to be accomplished it is required that the hair line be placed over the division representing 104.17, and the answer can be read on the C scale as 30.62 inches. If it is remembered that the slide is at the right the method of determining the position of the decimal point need present no difficulties, although the adding of one to the difference in the number of digits and the subtracting of one in the case of multiplying may seem complicated to the beginner. It will be seen that if the slide stays in the same position all the time one process offsets the other.

In order to carry out the other steps involving multiplication it will be necessary to set the line over the left hand index and then to set the slide so that the right hand index is under the line. Then it is simply necessary to move the line over 40 and 52.5 on the C scale and to read the answers on the D scale. It will be noticed that, although there are several results, it is not necessary to set the slide more than twice. In problems of this kind the slide rule is very useful in obtaining results.

The elevations at the various points referred to in the problem are $11\frac{3}{4}$ inches, 1 foot $3\frac{7}{16}$ inches, and 2 feet $6\frac{5}{8}$ inches.

To one who becomes accustomed to the use of the slide rule the problem of determining the number of risers in a stairway between two floors is not a lengthy one to solve. Suppose that it is necessary to find the number of risers required in a story height of 16 feet 4 inches, the risers to measure $7\frac{1}{2}$ inches if possible. It is first necessary to determine the number of inches in the story height, and this is accomplished easily by sliding the runner to one-two on the D scale and bringing the left hand index under the hair line. If the runner is moved to the right—over one-six on the C scale—the answer, 192 inches, can be read on the D scale. The story height actually measures 16 feet 4 inches, so the total number of inches is 196. Slide the runner to this and place seven-five on the C scale under the line. The nearest number of risers is found to be 26, but if this number is used each riser will have to be slightly more than $7\frac{1}{2}$ inches high. In order to find what the actual height will be it is only necessary to slide the C scale until two-six coincides with one-nine-six. The right hand index will be found to be adjacent to seven-five-four. It will be seen that the actual riser height is 7.54 inches. This method of calculating the number and heights of risers can be carried through on the slide rule in less time than it takes to read about it.

So far nothing has been said about obtaining square roots of numbers or cube roots, but with the ordinary slide rule the first process is very simple and with the polyphase rule the second is equally easy. All that it is necessary to do is to set the line at the number on the A scale of which the square root is required. However certain care should be exercised in doing this. It will be noticed that the A scale is divided into two parts which look exactly alike, but the divisions in the left hand section represent different positions of the decimal point than do the divisions in the right hand section. As an example, 4 in the left hand division represents 4, 400, 40,000 or a similar figure in which the decimal point is located at the right of an uneven number of digits, and 4 in the right hand section represents 40, 4,000 and any similar number in which the decimal point is located at the right of an even number of digits.

If it is necessary to find the square root of 4, it is simply necessary to place the line over 4 in the left hand section of the A scale and to read the answer, 2, on the D scale. In like manner if it is desired that the square root of 40 be obtained, then it is necessary to set the line at 4 in the right hand division and the answer is read as 6.325, the last digits being estimated. Although the method of obtaining square roots is not difficult, and the process of determining the squares of numbers is just the reverse of it, still it is much safer to use the C and D scales even in obtaining squares. If it is necessary to square 2 it is almost as simple to locate the left hand index at 2 on the D scale, and to slide the runner to 2 on the C scale, and to read the answer, 4, on the D scale, as it is to set the runner at 2 on the D scale and to read 4 on the A scale, and if the C and D scales are used there is no difficulty about placing the decimal point.

With the polyphase rule the K scale must be used in extracting the cube root. This scale is divided into three sections, and if it is desired to extract the cube root of a number between 1 and 10, then the line must be placed over the division in the first section which corresponds to this number and the cube root will be given on the D scale. As an example it can be assumed that it is desired to find the cube root of 8. Slide the runner to 8 in the first section of scale K and under the line on scale D will be found the answer, 2. In like manner, for numbers between 10 and 100 the second section must be used. Over 27 in the second section will be found 3 on the D scale. For numbers between 100 and 1,000 the third section must be used. Over 729 on the K scale—third section—will be found 9.

The examples which have been given have all been simple, but if the reader can understand the methods used, he will have little difficulty in carrying through even complicated problems. The methods must be thoroughly understood; after they have been mastered, practice will lead to very quick results.

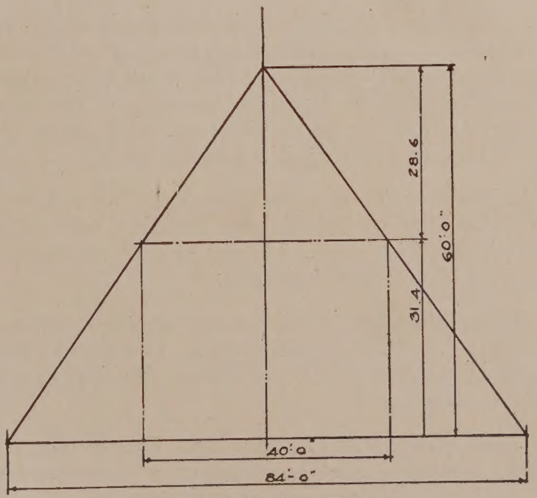


FIGURE 56

Announcements

John Galen Howard, architect, announces his association with E. Geoffrey Bangs, Henry C. Collins, Henry Temple Howard, and Charles F. B. Roeth, architects, for the practice of architecture under the name of John Galen Howard & Associates, Architects, First National Bank Building, San Francisco.

The Rochester Associated Architects and Engineers, Inc., announce the opening of an office for the practice of architecture and engineering at 600 Duffy-Powers Building, Rochester, N. Y. Manufacturers' samples and catalogues are desired.

Bertram A. Weber, architect, announces that he will continue the architectural practice of his father, Peter J. Weber, in his offices, Fisher Building, 343 South Dearborn Street, Chicago.

Francis Y. Joannes, architect, Robert C. Dunbar, Henry C. Hahn, associates, wish to announce the removal of their offices to the Park-Lexington Building, 247 Park Avenue, New York City.

John Sloan, architect, has removed his offices from the Straus Building to the twenty-sixth floor of the Pershing Square Building, 42d Street and Park Avenue, New York.

Henry J. Moloney, architect, formerly with Welles Bosworth and Thomas M. Jones, architects, and John J. Hallahan, bank equipment engineer, formerly with Art Metal Construction Company and Canton Art Metal Company, announce the formation of a partnership for general practice of architecture and bank equipment engineering, under the firm name of Moloney & Hallahan, Architects-Engineers, at 342 Madison Avenue, Canadian Pacific Building, New York. Manufacturers' samples and catalogues requested.

Glenn Allen, architect and manager of construction, is now located in the Union Block, 41 South Sutter Street, Stockton, Cal. Catalogues requested.

J. A. Altschuler, B.A., architect, has opened new offices at 115 East North Street, New Castle, Pa. Catalogues requested.

George Bain Cummings, registered architect, announces that he has admitted to partnership Fred Leonard Starbuck, registered architect, formerly of New York City, under the name of Cummings & Starbuck, architects. The firm will continue the practice of architecture, with offices at 520 Security Mutual Building, Binghamton, N. Y.

A. Thomson Thorne has moved his office from 1202 Cosden Building to 301 Roberts Building, 6th and Main Streets, Tulsa, Oklahoma. He will be glad to receive catalogues and manufactures' samples.

Harlan M. Clark, architect and engineer, has opened an office at 3115 Mapledale Avenue, Cleveland, Ohio, for the general practice of his profession. He will be glad to receive catalogues.

Jones, Roessle & Olschner and Samuel G. Wiener, B. S. A., announce the formation of a copartnership for the practice of architecture under the firm name of Jones, Roessle, Olschner & Wiener, with offices in the Ardis Building, Shreveport, La., and in the Maison Blanche Building, New Orleans, La.

Rudolph Weaver, A. I. A., announces his withdrawal from the State College of Washington to become university architect and professor of architecture in the University of Idaho, Moscow, Idaho.

Delos H. Smith, architect, announces the removal of his office to 1707 I Street, N. W., Washington, D. C.

Rodier & Kundzin, architects, announce the opening of offices at 1216 18th Street, N. W., Connecticut Avenue at Jefferson Place, Washington, D. C.

New York Society of Architects.—At the October meeting of the New York Society of Architects the discussion was centred upon the need of passing more effective restrictive laws against the practice of architecture by unregistered architects. It was suggested also that the Tenement House Law be so amended as to restrict the construction of tenements to registered architects only.

Elton J. Moughton announces the removal of his offices from 7 Miller Building to Suite 503–4 First National Bank Building, Sanford, Fla.

Martin A. Sheldon, architect, announces the removal of his offices to 950 Monadnock Building, Market Street near 3d, San Francisco.

Max L. Waeber, architect, announces the removal of his office to 78 Willoughby Street, near Bridge Street, Brooklyn, N. Y.

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